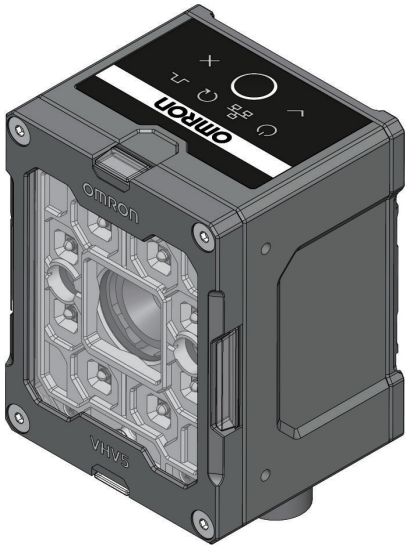
OMRON

Autofocus Multicode Reader

VHV5-F Series

User Manual for Communication Settings



Z477-E-01

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Introduction

Thank you for purchasing the VHV5-F Code Reader.
This manual contains information that is necessary for using VHV5-F Code Reader.
Please read this manual and make sure you understand the functions and capabilities before you attempt to use it in a control system.
Function Blocks Library and Sample Program for Omron Controllers are available for download.
Please, visit Omron website for Function Blocks Library and Sample Program for additional PLC / Controllers.
Keep this manual in a safe place where it will be available for reference during operation.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of introducing barcoding systems.
- Personnel in charge of designing barcoding systems.
- Personnel in charge of installing and maintaining barcoding systems.
- Personnel in charge of managing barcoding systems and facilities.

Applicable Products

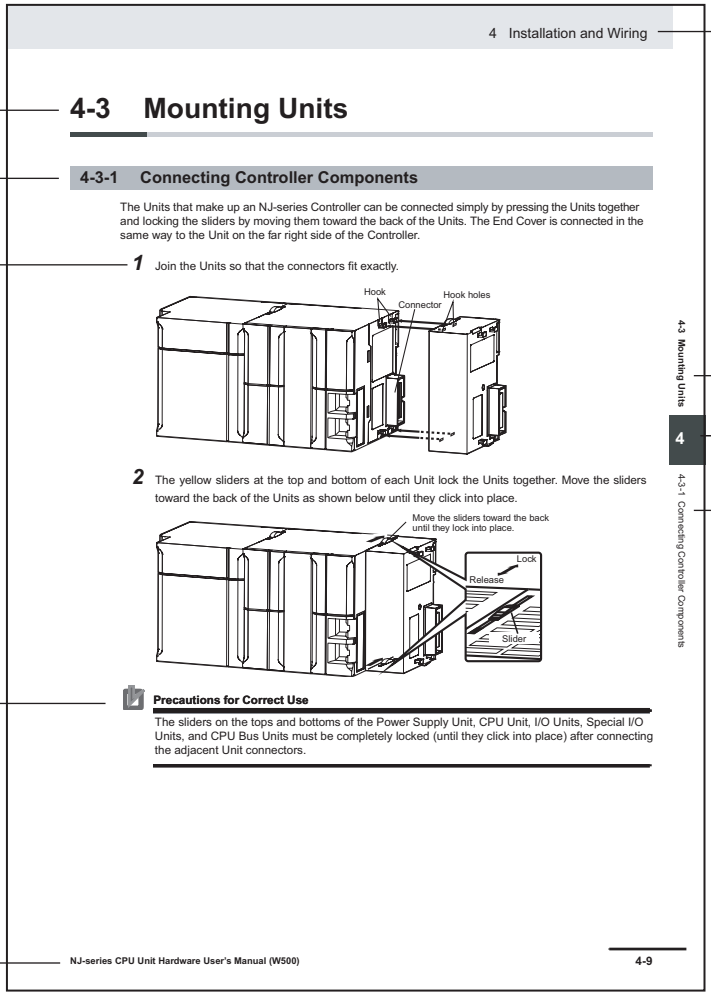
- VHV5-F Code Reader

Parts of the specifications and restrictions for each product may be listed in other manuals. Please refer to *Related Manuals* on page 16.

Manual Structure

Page Structure

The following page structure is used in this manual.



Level 2 heading — **4-3 Mounting Units**

Level 3 heading — **4-3-1 Connecting Controller Components**

A step in a procedure — ***1*** Join the Units so that the connectors fit exactly.

Indicates a procedure.

2 The yellow sliders at the top and bottom of each Unit lock the Units together. Move the sliders toward the back of the Units as shown below until they click into place.

Special information — **Precautions for Correct Use**

The sliders on the tops and bottoms of the Power Supply Unit, CPU Unit, I/O Units, Special I/O Units, and CPU Bus Units must be completely locked (until they click into place) after connecting the adjacent Unit connectors.

Icons indicate precautions, additional information, or reference information.

Manual name — NJ-series CPU Unit Hardware User's Manual (W500) 4-9

Level 1 heading — 4 Installation and Wiring

Level 2 heading — 4-3 Mounting Units

Level 3 heading — 4-3-1 Connecting Controller Components

Gives the current headings.

Page tab — 4

Gives the number of the main section.

Note : This page is a sample for the purpose of describing the page structure. It differs in its actual content.

Icons

The icons used in this manual have the following meanings.

Precautions for Safe Use

Precautions on what to do and what to avoid doing to ensure the safe use of the product.

Precautions for Correct Use

Precautions on what to do and what to avoid doing to ensure proper operation and performance.

Additional Information

Additional information to read as required.
This information is provided to increase understanding or make operation easier.

Version Information

Information on differences in specifications and functionality for Product with different product versions is given.

Sections in this Manual

CONTENTS

Terms and Conditions Agreement

Warranty, Limitations of Liability

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For details on Safety Precautions, please refer to *Safety Precautions* in *Autofocus Multicode Reader VHV5-F Series User Manual (Z476-E (84-9000xxx-xx))*.

Precautions for Safe Use

For details on Precautions for Safe Use, please refer to *Precautions for Safe Use* in *Autofocus Multicode Reader VHV5-F Series User Manual (Z476-E (84-9000xxx-xx))*.

Precautions for Correct Use

For detailed precautions on the correct use of the product, please refer to *Precautions for Correct Use* in *Autofocus Multicode Reader VHV5-F Series User Manual (Z476-E (84-9000xxx-xx))*.

Regulations and Standards

For details on Regulations and Standards, please refer to *Regulations and Standards* in *Autofocus Multicode Reader VHV5-F Series User Manual (Z476-E (84-9000xxx-xx))*.

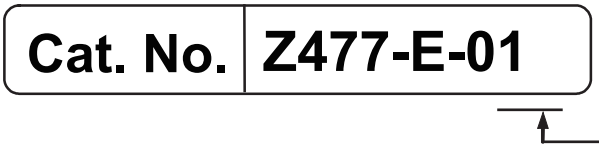
Related Manuals

The followings are the manuals related to this manual. Use these manuals for reference.

Name of Manual	Cat. No.	Model	Usage	Description
VHV5-F Code Reader User Manual	Z476	VHV5-F Code Reader	When you want to know the product specifications and basic settings for using the VHV5-F Code Reader	VHV5-F Code Reader specifications, getting started, explanation of settings, command parameters.
VHV5-F Code Reader Communication Manual	Z477		When you want to operate the VHV5-F Code Reader from an external device	It describes the system configuration, control methods, I/O specifications, supported network types and communication setting for using the VHV5-F Code Reader.
Sysmac Studio Version 1 Operation Manual	W504	SYSMAC -SE2□□□	Learning about the operating procedures and functions of the Sysmac Studio.	Describes the operating procedures of the Sysmac Studio.
NJ/NX-series CPU Unit Built-in EtherNet/IP™ Port User's Manual	W506	NX701-□□□□ NX502-□□□□ NX102-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Using the built-in EtherNet/IP port on an NJ/NX-series CPU Unit.	Information on the built-in EtherNet/IP port is provided. Information is provided on the basic setup, tag data links, and other features.
EtherNet/IP™ Units Operation Manual	W465	CJ1W-EIP21	Learning how to use CJ-series EtherNet/IP Units.	Provides information on operating and installing EtherNet/IP Units, including details on basic settings, tag data links, and FINS communications.
CJ-series EtherNet/IP™ Units Operation Manual for NJ-series CPU Unit	W495	CJ1W-EIP21	Learning how to use CJ-series EtherNet/IP Units with an NJ-series CPU Unit.	Information on using an EtherNet/IP Unit that is connected to an NJ-series CPU Unit is provided. Information is provided on the basic setup, tag data links, and other features.

Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.



Revision Code	Date	Revised Content
01	May 2024	• First Publication.

1

Communication Specifications Overview

This section provides a basic overview of the communications specifications and methods for controlling the code readers. This information is required before performing communications between the VHV5-F Code Reader and an external device.

1-1 Confirming the System Configuration

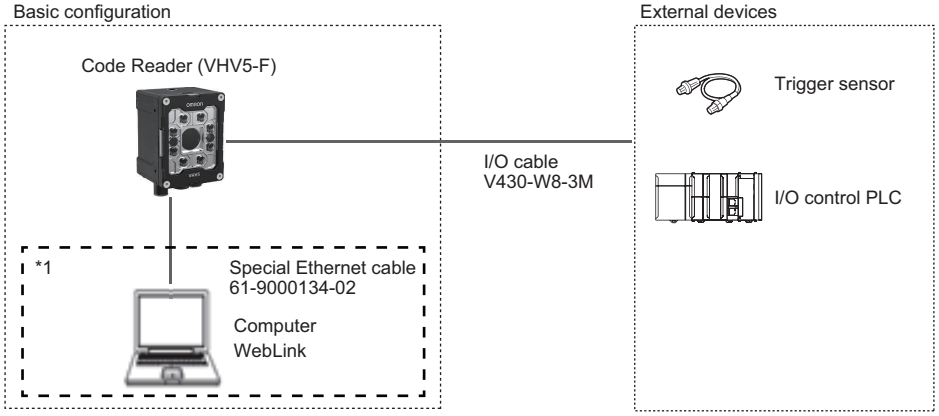
This product is a multi-code reader that captures images of 1D symbols (barcodes) and 2D Symbols and reads and processes their embedded data.
In a system configuration in which it is connected to a PLC, PC, or other external device, serial commands can be received from, and code reading results can be output to the external device.

1-1-1 VHV5-F System Configuration

The VHV5-F can be used in the following types of system configurations.

Connection using Parallel I/O Interface

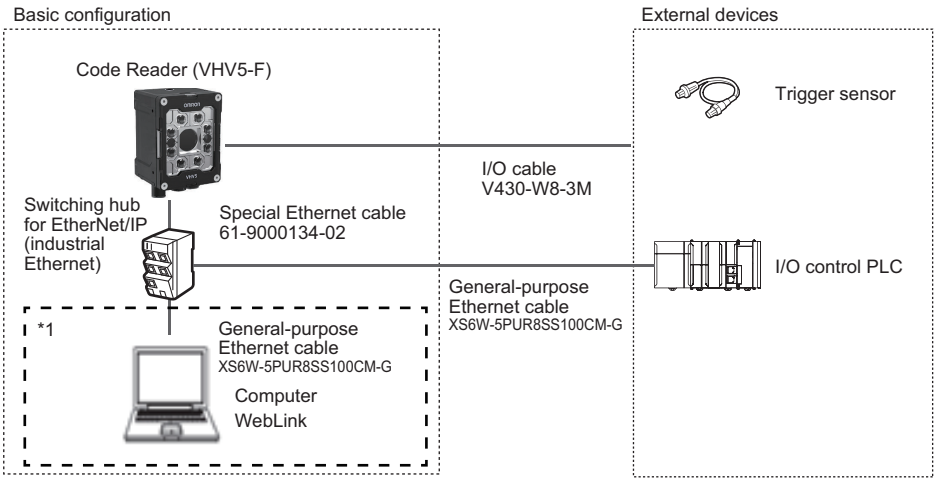
Trigger inputs and OK/NG Judgement result outputs are received and sent over I/O cable.



*1 If monitor display is not required, it is not necessary to connect with a PC during operation.

Connecting over Ethernet (EtherNet/IP, Serial (TCP), PROFINET)

Establish network connections via an Ethernet cable to input triggers and communication commands and to output reading results (Judgment results and decoded content). Using the data link function for each network (excluding Serial), data transfer can be done periodically between the code reader and the external device.

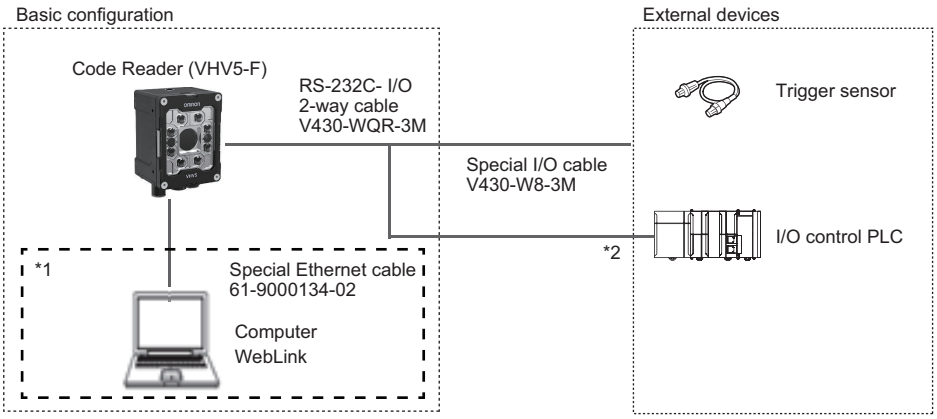


*1 If monitor display is not required, it is not necessary to connect with a PC during operation.

Connecting by PoE (Power over Ethernet)

Connecting by Serial (RS-232)

Triggers and Serial command input, as well as Read result judgement and Read string content data output is transmitted over RS-232C cable. Triggers can also be input over parallel I/O.



*1 If monitor display is not required, it is not necessary to connect with a PC during operation.

Additional Information

The cable to use for Serial (RS-232C) communication is RS-232C-I/O Y cable (V430-WQR-3M). Please use this cable when connecting to a PC by RS-232C.
When connecting with OMRON CS/CJ/NJ series controller, connect OMRON Programmable Controller (CS/CJ/NJ) RS-232C cable (V430-WPLC-2M) between RS-232C-I/O Y cable (V430-WQR-3M) and I/O control PLC (*2 in the figure).
For wiring different from the above, either make your own converter cable, or use the discrete wire cable type (V430-W8□ Series) with its RxD signal and TxD signal converted.

1-2 Communicating with an External Device

This section gives the communications specifications, describes the control methods that you can use for communications, and describes the settings that are required before starting communications with an external device.

1-2-1 Basic Control Operations of the Code Reader

The following figure shows basic communications between an external device and the code reader and the flow of signals and data.

The following methods can be used to exchange data between an external device and the code reader.

Commands that can be input to the code reader from an external device

Type		Description
Control Commands	Control Signals (Input Signals)	Reading is executed when a trigger (Trigger signal: ON) is input.
	Communication Command Input	Various commands can be executed, such as a Read commands (trigger) and commands to change settings. The communication commands differ depending on the communications protocol that you use.

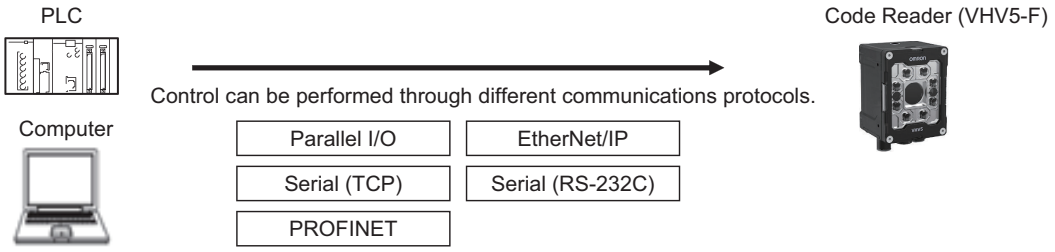
Data output from the code reader to an external device

Type	Description
Status Signals	When the code reader confirms the input of a control signal or communication command and starts the reading process, it notifies the external device of its status (by signals such as Cycle Complete, etc.) and its judgement with the OK/NG Judgment signal.
Read Character String Output	You can output the character string read from barcodes, or 2D Codes
Additional Information	Additional data such as print quality grade and code position coordinates can be output. For these items to be appended to the output, they must be setup in advance in WebLink's advanced settings menu.

1-2-2 Applicable Communications Protocols for the VHV5-F

The VHV5-F can be controlled from a PLC, computer, or other external device using various communication protocols.

The following types of communication protocols can be used for controlling the VHV5-F from an external device.



Applicable Communications Protocols

○: Supported -: Not supported

Communication Method	Communication Protocol	Description	Communication Cable Type		
			Parallel I/O	Ethernet	RS-232C
Digital Input / Output Interface	Parallel I/O	Data is exchanged between an external device and the reader through physical trigger contact (Digital Input) and three programmable physical signals (Digital Outputs).	○	-	-
Data Sharing	EtherNet/IP	This is an open communications protocol. Tag Data Links are used for communication with the reader. On the PLC, structured variables are created that correspond to the control signals, Command/Response data, and Read data. These variables are then used as I/O Tag Data Links to exchange data cyclically between the PLC and the reader.	-	○	-
	PROFINET	This is an open communications protocol. Software-based RT (Real-time) communications, (SRT) is used for communication with the reader. The control signals, Command Area/Response Area, and area to store Read result data are assigned in the I/O memory of the PLC, and data is exchanged cyclically between the PLC and the reader.	-	○	-

Communication Method	Communication Protocol	Description	Communication Cable Type		
			Parallel I/O	Ethernet	RS-232C
Frame Transmission	Serial (TCP)	Command frames are sent to the reader and Response frames are received from the reader without the use of any specific protocol. Data can be exchanged between the PLC, computer, or other external device and the reader in ASCII format.	-	○	-
	Serial (RS-232C)	Data can be exchanged in ASCII format over the RS-232C cable connection between the reader and its controlling device (PLC, PC, or other external device).	-	-	○

Simultaneous Use of Communication Methods and Connections

○: Supported -: Not supported

Code reader Connection Method	Simultaneous Connection Method	
	EtherNet/IP	PROFINET
EtherNet/IP	N/A	-
PROFINET	-	N/A
Serial (TCP)	○	○
Serial (RS-232C)	○	○
Parallel I/O	○	○

Additional Information

About connections over network routers
WebLink can connect to code readers on different networks across routers.
- To connect to the code reader, enter code reader's IP address from the browser.
- Set a fixed IP address for the code reader you wish to connect to.

2

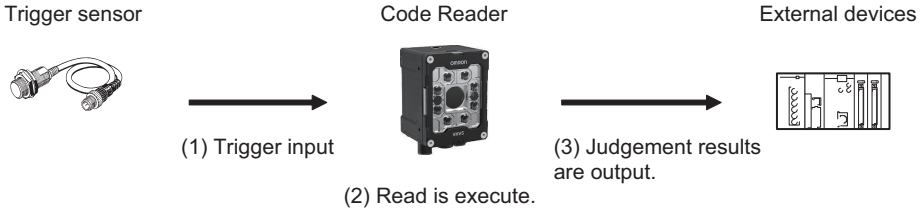
Controlling Operation and Data Output with Parallel I/O

2-1 Controlling Operation and Data Output with Parallel I/O

This section explains how to connect the code reader to an external device by the I/O cable and the methods that you can use to control the code reader from the external device.

2-1-1 Basic Operation with a Parallel I/O Connection

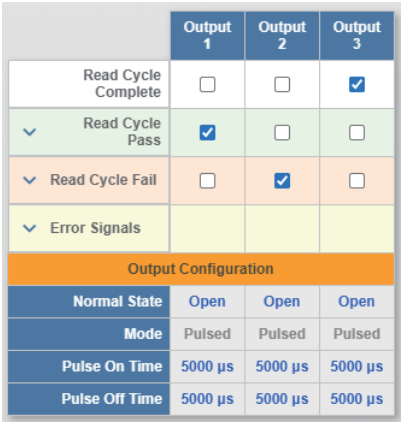
This section describes the basic connections and signal flow with external devices.
Operation for one of the primary uses is described in the example below.



Example of Trigger Input and Output Signal

Below is an output assignment example and timing chart for a triggered read cycle.
[Example assignment of OUTPUT signals]

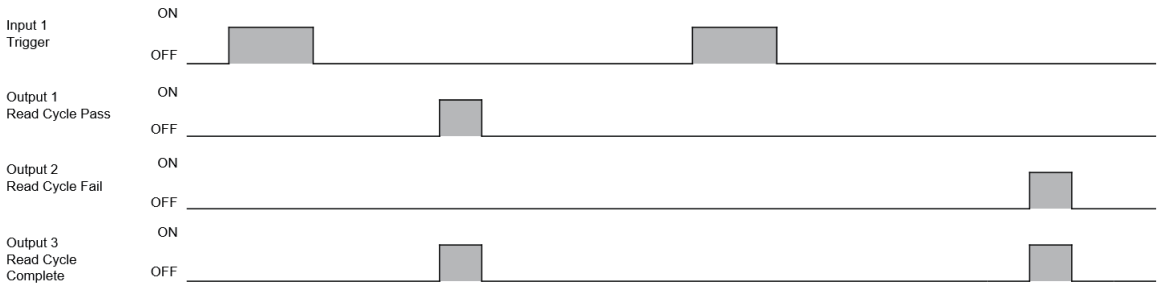
- Output 1: Read Cycle Pass
  This output is ON when all codes were found, all codes were the correct type, and all were read and matched (i.e. contained the correct string content).
- Output 2: Read Cycle Fail
  This output will be ON at the end of read cycle when either not all codes were code present, were not of the correct type, or did not read or match (did not contain the correct string content).
- Output 3: Read Cycle Complete
  Output is ON when the read cycle completes.



	Output 1	Output 2	Output 3
Read Cycle Complete	☐	☐	☑
Read Cycle Pass	☑	☐	☐
Read Cycle Fail	☐	☑	☐
Error Signals			
Output Configuration			
Normal State	Open	Open	Open
Mode	Pulsed	Pulsed	Pulsed
Pulse On Time	5000 µs	5000 µs	5000 µs
Pulse Off Time	5000 µs	5000 µs	5000 µs

For how to set up the Output signal assignments, please refer to *How to Assign the Output Signals* on page 2-11.

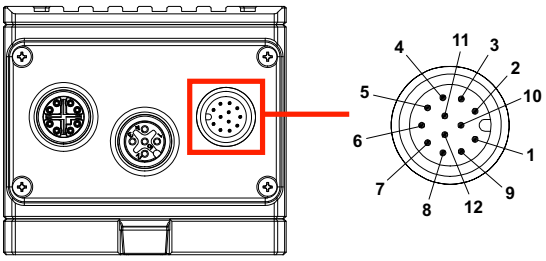
<Timing Chart>



*1 For how to change the length of time to hold the signal, please refer to *2-1-7 Change the Assignments for the Output Signal (Output 1 to 3) ON Condition* on page 2-24.

2-1-2 VHV5-F Wiring and Electrical Specifications for Parallel I/O

The following is the wiring diagram of the power cable to connect to the VHV5-F (All V430-W8).
The Parallel IO Port connector is used for Digital Inputs (Trigger), Digital Outputs, RS-232, and Power.
The following sections describe how to wire the Inputs, Outputs, and Power.

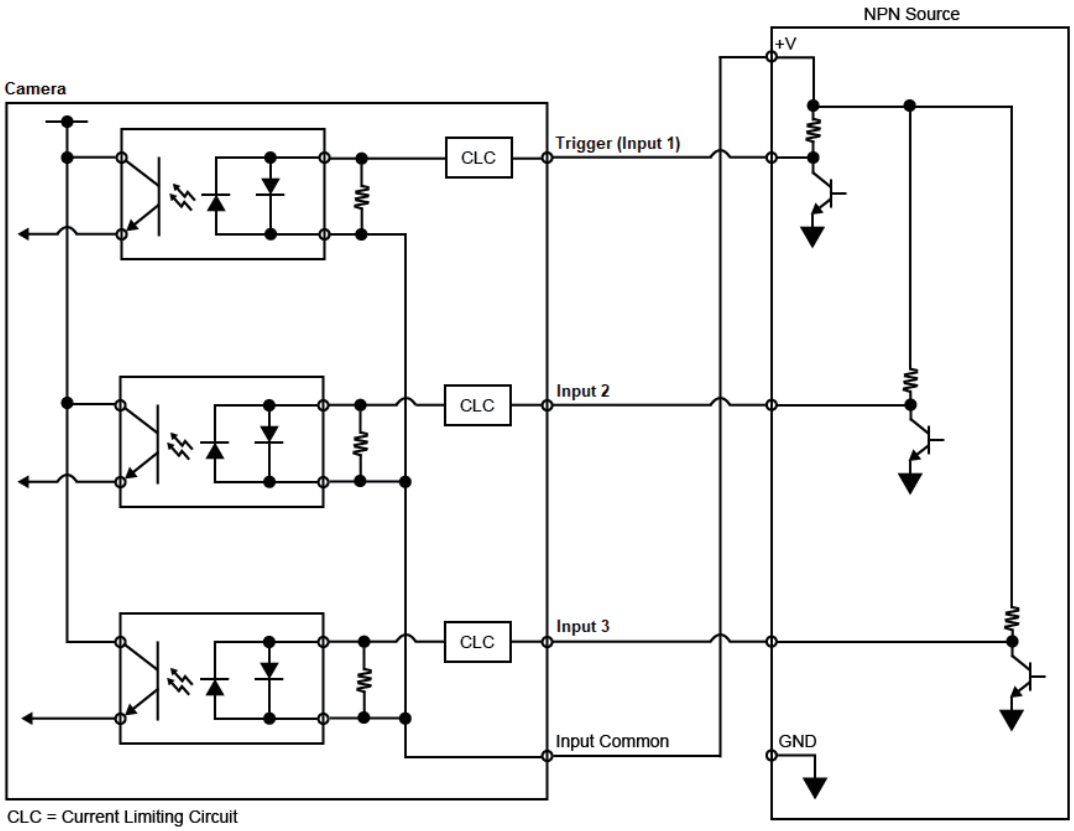


Pin	Name	Function	Flying Lead Color
1	Trigger (Input 1)	Trigger	WHITE
2	Power (+VIN)	24 Volts	BROWN
3	Input 3	General Purpose Input	GREEN
4	Input 2	General Purpose Input	YELLOW
5	Output 1	General Purpose Output	GRAY
6	Output 3	General Purpose Output	PINK
7	Ground (-VIN)	24V Reference (GND)	BLUE
8	Input Common	NPN or PNP Common for Input	RED
9	RS-232 (Host) RxD	Serial Command Input	BLACK
10	RS-232 (Host) TxD	Serial Data Output	VIOLET
11	Output 2	General Purpose Output	GRAY STRIPED
12	Output Common	NPN or PNP Common for Output	RED STRIPED

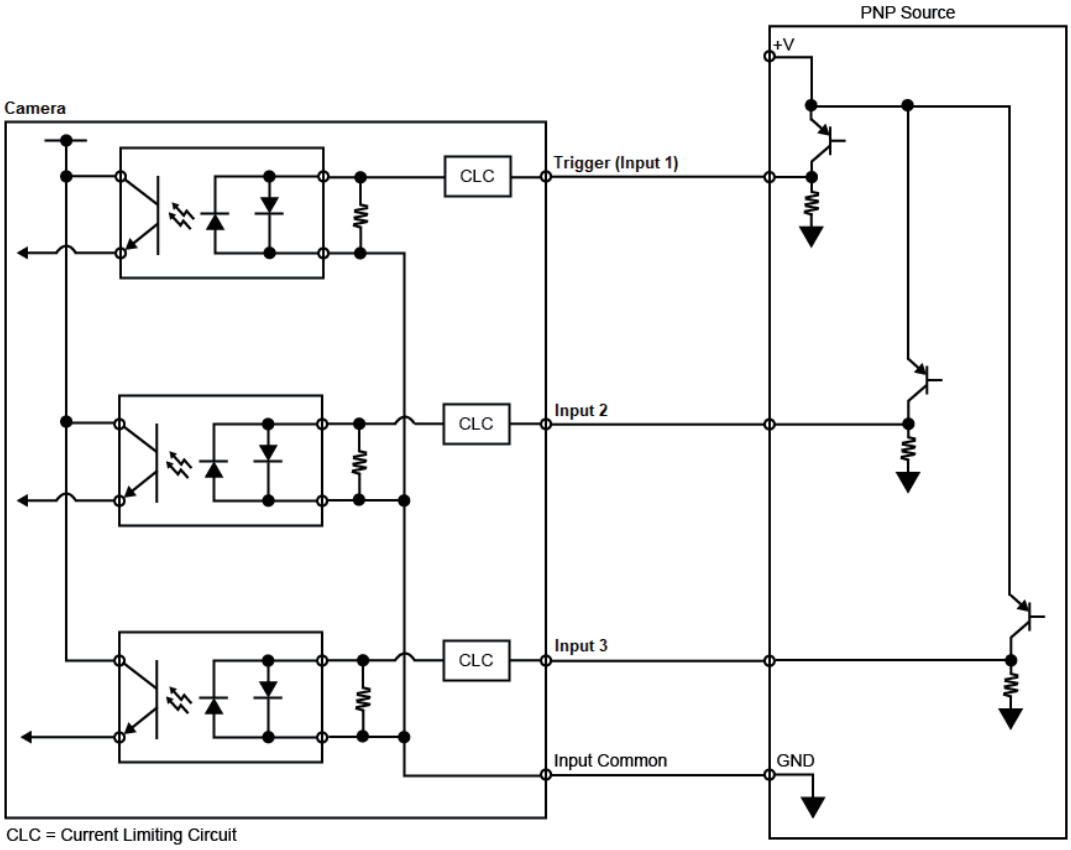
Digital Input Wiring

There are three digital inputs: Trigger (Input1), Input 2, and Input 3, as well as Input Common. The Trigger input is a high-speed, very-low-latency input for the fastest response from trigger to image acquisition. All inputs are wired the same. See the figures below for NPN and PNP Input wiring.

NPN Input


NPN Source
+V
Camera
CLC
Trigger (Input 1)
CLC
Input 2
CLC
Input 3
Input Common
GND
CLC = Current Limiting Circuit

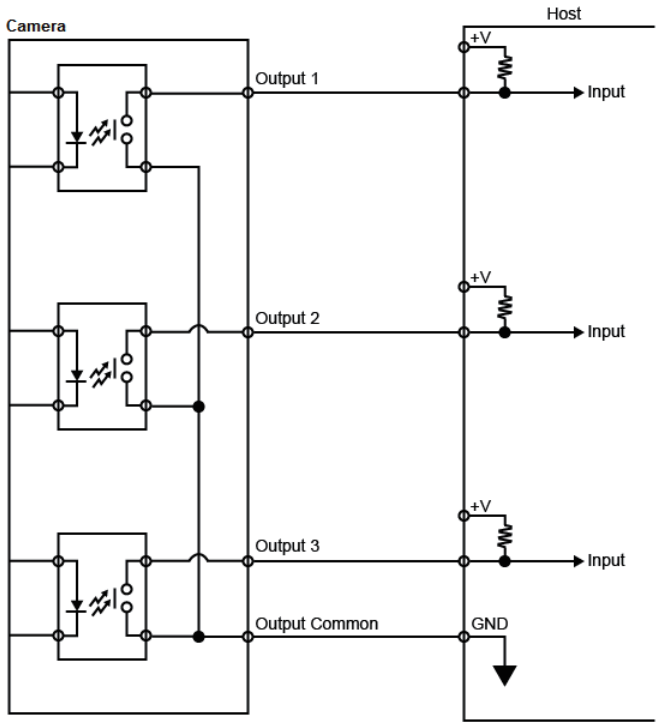
PNP Input



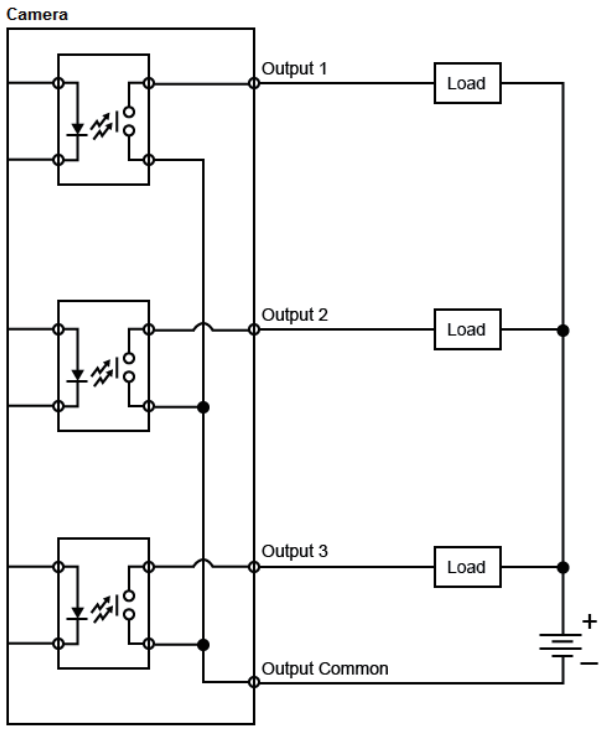
Digital Output Wiring

There are three digital outputs available for general use: Output 1, Output 2, and Output 3, as well as Output Common. Output 3 is a very-high-speed output that can be used for general purpose or as a strobe trigger to an external light other than the one connected to the reader's dedicated lighting port. See the figures below for NPN and PNP Output wiring.

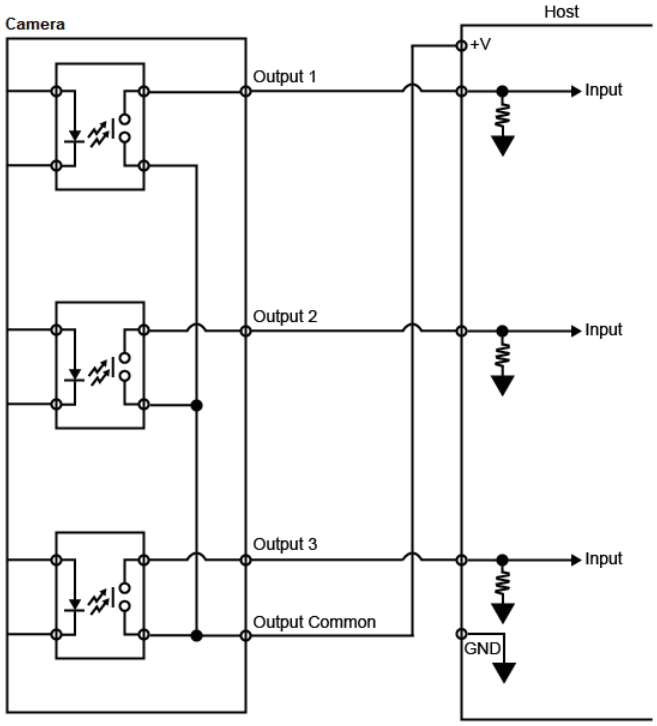
NPN Output for Host Input



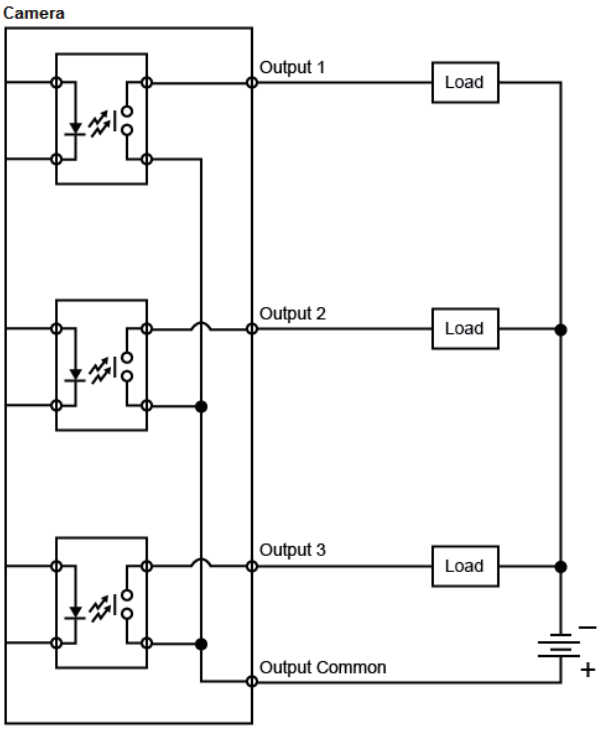
NPN Output for External Load



PNP Output for Host Input



PNP Output for External Load



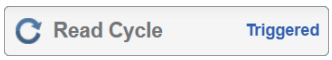
2-1-3 Change the Behavior of Operation

The following changes are possible depending on the system configuration and usage.

Type	Modification
Change the Type of Trigger	Change the method used to trigger a Read (Triggered, Continuous, Presentation Mode, or Start Stop)
Change the Mode Operation of the Output Signal (Output 1 to 3)	Change the ON operation mode for Output 1 to 3 (Pulsed or Latched)
Change the ON and OFF timing of the Output Signal (Output 1 to 3)	Change the ON and OFF timing of the Output 1 to 3 (Available for Pulsed Operation Mode only)

2-1-4 Change the Type of Trigger

It is possible to change the input method for the trigger used by the code reader to execute image capture.
Read Cycle is the first step in the Read Sequence. This step controls how the Read Cycle operates from Trigger to Answer.

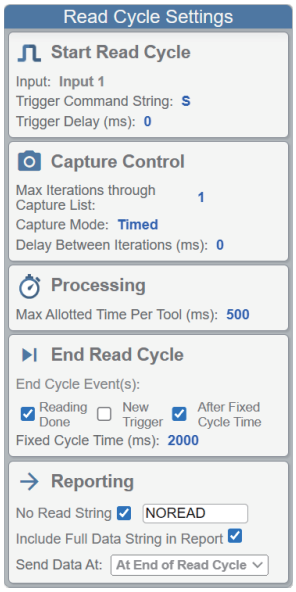


The Read Cycle step exposes one parameter, the Read Cycle Type. This can be changed by the user during setup for testing purposes, but it is recommended that the job be created with the desired Read Cycle type when user “Creates New Job”.

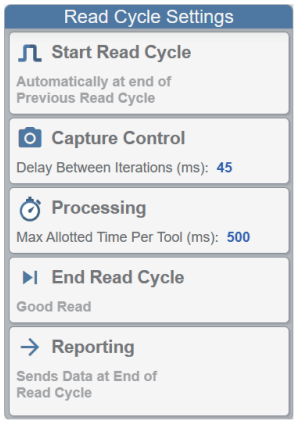
Clicking on the Read Cycle will highlight the step in light blue and will open up the specific Read Cycle Settings dialog in the right hand pane for that read cycle mode. The settings dialog allows the user to change parameters within the five read cycle control sections.
When the user clicks on the Read Cycle step on the left side of the UI, the Read Cycle Settings Dialog appears on the right allowing the user to tailor how the read cycle will run.

Below are the four variations of the Read Cycle Settings dialog for the four different read cycle types.The default settings can be used as-is for most applications.

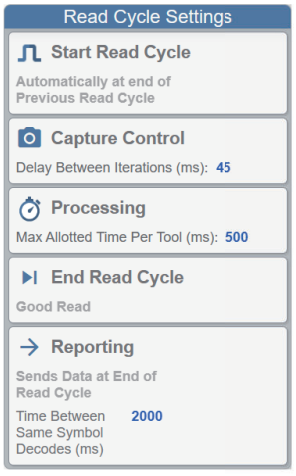
Triggered



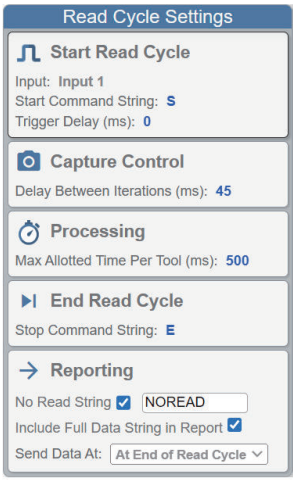
Continuous



Presentation



Start / Stop

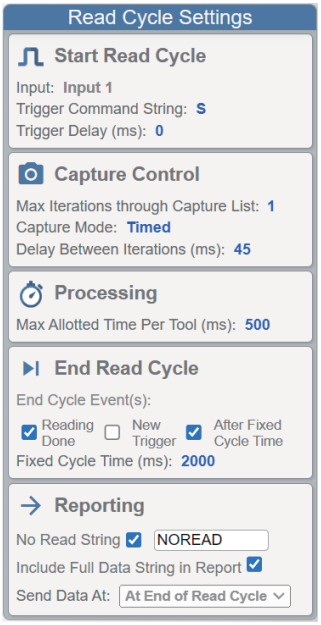


Individual parameter settings for each read cycle type vary, but the control sections are the same for all. **The control sections mimic the flow of operation of the read cycle.** They start at the top of the dialog with the event that Starts the Read Cycle, and conclude at the bottom with the event that Ends the Read Cycle and directions on how and when to report the read cycle data.

The control sections following the flow of Read Cycle operation are:

1. Start Read Cycle
2. Capture Control
3. Processing
4. End Read Cycle
5. Reporting

The Triggered read cycle is the most complex. It will be explained in detail here. The following sections for the Continuous, Presentation and Start/Stop read cycle types should be read after reading this section. The read cycle operational flow sections are **Start Read Cycle**, **Capture Control**, **Processing**, **End Read Cycle**, and **Reporting**.



Triggered is the most common Read Cycle type. Here, the system receives a specific trigger indicating the part is in front of the reader. The trigger starts the Read Cycle. Within the read cycle, the reader acquires a fixed set of images, and attempts to read within those images. The read cycle ends either when it has read, or when it runs out of images and still fails to decode. The next read cycle starts when a new trigger is received.

This section allows user to set up how the read cycle will be started or triggered.

Physical Trigger – The cycle can be started with a physical trigger on Input 1.

Start Command String – The cycle can be started with a serial trigger through RS-232 or TCP/IP socket. This is either a character or a string defined by the user.

PLC Trigger – It can always be started via PLC command if the Protocol is active.

Trigger Delay (msec) is used to hold off acquisition for a fixed time after the trigger is received. This allows the user to programmatically align the part in the field of view without having to go onto the line and change the physical trigger location.

Capture Control

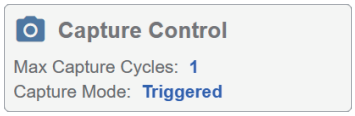
With the read cycle started, this section gives the user detailed control over the image Capture sequence within the Acquire step.

Max Iterations through Capture List – When Iterations is set to one, the system will acquire each image in the Capture List just one time in an attempt to decode. If the codes are not found within those images, then read cycle will fail. When Iterations is set above one, the system will acquire all images in the Capture List over and over until all codes are found, or until reaching the maximum iterations. A good application example for multiple iterations would be waiting for an unknown height part pass in front of a camera. Here, all captures can be set to different focus distances, and the system will cycle through these focus distances over and over while waiting for the part.

Capture Mode (Timed) and Delay Between Iterations (Of the Capture List) – The delay refers to a delay inserted between full iterations, or times to cycle through the Capture List. The main purpose of this is to allow system processing to keep pace with the flood of image that would come in if this value was set to 0.

Note: There is no delay inserted between individual captures in the list. These images are taken back to back.

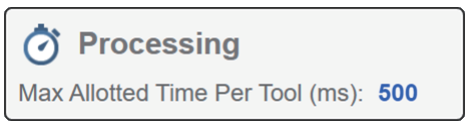
Capture Mode (Triggered) – When this mode is set to Triggered, the system will start the Read Cycle on the first trigger. Each subsequent Iteration through the capture list is started with a secondary trigger. It is a requirement in this mode that the number of triggers sent to the reader equals the number of Iterations, or the reader and controlling system will get out of sync.



Processing

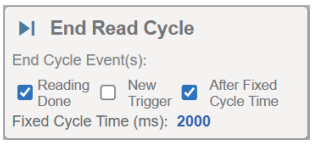
Once the flow of Captured images start, decoding starts. This section gives the user control over X-Mode decode tool processing. The single parameter is:

Max Allotted Time Per Tool (msec) – This parameter sets the maximum amount of time that any instance of the X-Mode decoder will be allowed to run. If X-Mode has not decoded within this amount of time, that X-Mode processing thread will be shut down. This parameter is useful for performance optimization. A good example would be the case of looking at Captures set to different focus heights. If it is known that the target code can be read easily within 20 msec in a focused image, but takes up to 50 msec to fail in an unfocused image, the max time could be set to 25 msec so the system does not waste processing time.



End Read Cycle

This section is used to determine when and for what reason the read cycle ends.



There are three main options. They can be chosen separately or in combination.

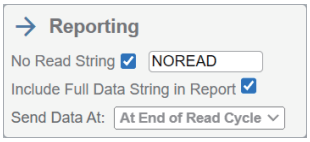
Reading Done – The read cycle will end when all X-Mode processing has completed. It is not required that all X-Modes have found a code, just that they have processed through the entire set of available Captures and conclude with either a Read or a No Read.

New Trigger – The read cycle will end if a new trigger comes in while the current read cycle is still active. The current read cycle will fail, passing on whatever partial result it has in the read cycle report. This mode is useful to prevent the line from falling behind the triggers that are coming in.

After Fixed Cycle Time/Fixed Cycle Time (msec) – These parameters set a fixed time after having received the trigger that the read cycle has to end. It can be used to stop the cycle early. If any processing is still running this will shut it down and the report will be sent. This parameter can also be used to extend the read cycle. If processing is done, but the PLC or other host expects the result at a fixed time after the trigger, this parameter will hold off sending the data until the exact Fixed Cycle Time.

Reporting

This section is used to how the output string is composed, if it should be sent, and when to send it.



No Read String – If checked, the text from the No Read String text box will be used as the string content for any Decode Tools that have failed.

Include Full Data String in Report – By default, the final output string is transmitted out all TCP/IP and RS-232 ports that are enabled When this option is unchecked, the string is not sent.

Note1: This setting does not affect PLC based communication. The output string is always set into the PLC Input Assembly.

Note2: This setting also does not affect Digital Outputs. The outputs will always be set at the end of the Read Cycle reflecting read cycle status.

Send Data At – This controls when the read data is sent.

- **At End of the Read Cycle –** This is the default behavior. The data string is sent at the end of the read cycle. The end of the read cycle is set as when Reading is Done, or when a New Trigger is issued, or After Fixed Cycle Time.
- **As Data is Decoded –** This option is only relevant for the After Fixed Cycle Time option. If this is set, the reader will send the string data to the host immediately, but will not set Pass/Fail or End of

Cycle digital outputs until the Fixed Cycle Time is complete.**Note:** This does not affect PLC communication. The PLC data is always set at the end of the read cycle.

Triggered Read Cycle Settings

Item	Setting value [Job Default]	Description
Start Read Cycle		
Input	**[Input 1 - Trigger]**	Digital Input 1 is the dedicated Trigger Input. The Start/Stop cycles starts when the Input is Activated.
Trigger Command String	Any String, **[S]**	Serial string used to Start the read cycle when commanded by RS-232 or Socket. Note: Non printable characters are not allowed, with the exception of space. Here, the user must type in an actual space with space bar. This will be displayed as <SP>.
Trigger Delay (msec)	**[0]-1000**	Trigger Delay (msec) is used to hold off acquisition for a fixed time after the trigger is received. This allows the user to programmatically align the part in the field of view without having to go onto the line and change the physical trigger location.
Capture Control		
Max Iterations Through the Capture List	**[1]-N**	When Iterations is set to one, the system will acquire each image in the Capture List just one time in an attempt to decode. If the codes are not found within those images, then read cycle will fail. When Iterations is set greater than one, the system will acquire all images in the Capture List over and over until all codes are found, or until reaching the maximum number of iterations.
Capture Mode	**[Timed]**, Triggered	Timed – Inserts “Delay Between Iterations” between each cycle through the Capture List. The main purpose of this is to allow system processing to keep pace with the flood of image that would come in if this value was set to 0. Triggered - When this mode is set to Triggered, the system will start the Read Cycle on the first trigger. Each subsequent Iteration through the capture list is started with a secondary trigger. It is a requirement in this mode that the number of triggers sent to the reader equals the number of Iterations, or the reader and controlling system will get out of sync.
Delay Between Iterations (msec)	0-10000 **[45]**	Delay inserted between running iterations of the full image Capture List to allow processing to keep up with image acquisition. No delay is inserted between individual Captures within the list. They run back to back.
Processing		
Processing – Max Allotted Time Per Tool (msec)	0-10,000 **[500]**	This parameter sets the maximum amount of time that any instance of the X-Mode decoder will be allowed to run. If X-Mode has not decoded within this amount of time, that X-Mode processing thread will be shut down.
End Read Cycle		

Item	Setting value [Job Default]	Description
Reading Done	Unchecked, **[Checked]**	The read cycle will end when all X-Mode processing has completed. It is not required that all X-Modes have found a code, just that they have processed through the entire set of available Captures and conclude with either a Read or a No Read.
New Trigger	**[Unchecked],** Checked	The read cycle will end if a new trigger comes in while the current read cycle is still active. The current read cycle will fail, passing on whatever partial result it has in the read cycle report. This mode is useful to prevent the line from falling behind the triggers that are coming in.
After Fixed Cycle Time	Unchecked, **[Checked]**	This parameter sets a fixed time after having received the trigger that the read cycle has to end. It can be used to stop the cycle early. If any processing is still running this will shut it down and the report will be sent. This parameter can also be used to extend the read cycle. If processing is done, but the PLC or other host expects the result at a fixed time after the trigger, this parameter will hold off sending the data until the exact Fixed Cycle Time
Fixed Cycle Time (msec)	0-60,000 **[2000]**	Fixed amount of time to end the Read Cycle and send the report data
Reporting		
No Read String	Unchecked,**[Checked]** and string to send **[NOREAD]**	Controls what is output for Decode Tools that fail to Read. By default the string is set to NOREAD.
Include Full Data String In Report	Unchecked, **[Checked]**	By default, the final output string is transmitted out all TCP/IP and RS-232 ports that are enabled When this option is unchecked, the string is not sent. Note1: This setting does not affect PLC based communication. The output string is always set into the PLC Input Assembly at the end of each Read Cycle. Note2: This setting also does not affect Digital Outputs. The digital outputs will always be set at the end of the Read Cycle to reflect the current read cycle status.
Send Data At	**[At End of Read Cycle]**, As Data is Decoded	Determines timing for sending out Format Output string from Read Cycle. Either it sends it out at the end of the cycle, or it sends it out as soon as all Decode Tools Qualify.

Continuous Mode Overview

For Continuous mode, the reader starts acquiring images automatically upon entering Run Mode and attempts to read within those images. The reader will continue indefinitely to acquire and process until a part enters the field of view and the codes on that part are read. **Only a successful read will end the Continuous read cycle.** At the end of the Read Cycle, the read data is output, and then the next read cycle is started automatically, again waiting for a part to pass in front of the reader and be read.

Note: Continuous will read the same codes over and over in this mode until the part is moved out of the field of view.

The Continuous and Presentation Mode read cycles are exactly the same except for one important difference: In Presentation mode, after Reporting, the cycle will pause for a set time before restarting the next read cycle. This is to keep the reader from outputting the string data for the same code multiple times.Presentation mode is sometimes called Supermarket mode. It works like retail scanners, where a delay is inserted after the decode to allow the part to move out of the field of view so the same product won't be scanned multiple times.

Continuous Mode **Presentation Mode**

Start Read Cycle

Both modes start the first read cycle automatically when the job is loaded, and the restart the next read cycle after all Decode Tools have completed successfully. The read cycle will not end until it has Good Reads for all Decode Tools.

Capture Control

This mode can work with one or multiple Captures in the Acquire Step. The full set of Captures are set up to be able to find the code in all situations, such as at different focus distances the part might be at, at different brightness levels, or even with different lighting.

Delay Between Iterations (of the Capture List) – The reader will cycle through the full Capture List over and over indefinitely until all codes are found. The user normally inserts this delay to allow system processing to keep pace with the flood of image that would come in if this value was set to 0.

Processing

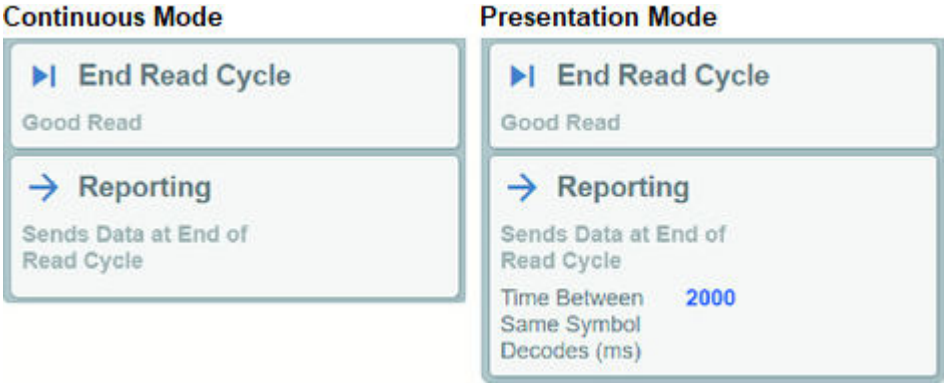
Once the flow of Captured images start, decoding starts. This section gives the user control over X-Mode decode tool processing. The single parameter is:

Max Allotted Time Per Tool (msec) – This parameter sets the maximum amount of time that any instance of the X-Mode decoder will be allowed to run. If X-Mode has not decoded within this amount of time, that X-Mode processing thread will be shut down. This parameter is useful for performance optimization. A good example would be the case of looking at Captures set to different focus heights. If it is known that the target code can be read easily within 20 msec in a focused image, but takes up to 50 msec to fail in an unfocused image, the max time could be set by the user to 25 msec so the system does not waste processing time trying to decode within an image that does not have good focus.

End Read Cycle and Reporting

Each read cycle ends on a Good Read meaning all Decode Tools have fully qualified. The Report is sent out immediately at the end of the Read Cycle. The next cycle will restart automatically. In Continuous Mode the next cycle starts instantly. In presentation mode, the restart is delayed a user programmable amount to prevent duplicate reading of the same code.

Time Between Same Symbol Decodes (msec) – Time delay before restarting next cycle to allow previous part to clear the field of view. This prevents duplicate reading of the same code. This value is set to 2 seconds by default.

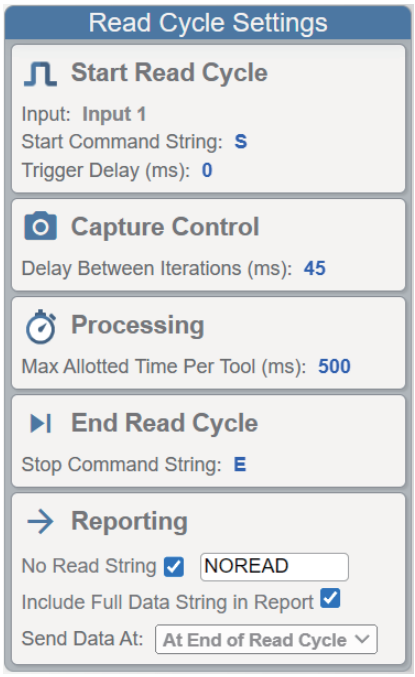


Continuous and Presentation Read Cycle Settings

Item	Setting value [Job Default]	Description
Start Read Cycle		
Automatically at end of previous Read Cycle	Default. No other choice.	Continuous and Presentation Read Cycles start automatically when job is loaded, and restart automatically at the end of the read cycle.
Capture Control		
Delay Between Iterations (msec)	0-10,000 **[45]**	Delay inserted between running iterations of the full image Capture List to allow processing to keep up with image acquisition. No delay is inserted between individual Captures within the list. They run back to back.
Processing		
Max Allotted Time Per Tool (msec)	0-10,000 **[500]**	This parameter sets the maximum amount of time that any instance of the X-Mode decoder will be allowed to run. If X-Mode has not decoded within this amount of time, that X-Mode processing thread will be shut down.
End Read Cycle		
Good Read	Default. No other choice.	Continuous and Presentation Read Cycles will run indefinitely until they get a good read (all decode tools qualify)
Reporting		
Send Data at End of Read Cycle	Default. No other choice.	The report containing read string data, as well as setting of Digital Output and communication to PLC is done as last step at end of read cycle.
Time Between Same Symbol Decodes (msec)	0-60,000 **[2000]**	**Presentation Mode Only** – Time delay before restarting next cycle to allow previous part to clear the field of view. This prevents duplicate reading of the same code. This value is set to 2 seconds by default

Start / Stop Mode Read Cycle Dialog

Start/Stop Mode is the final read cycle type. It is a combination of Triggered and Continuous mode. Please read these sections first for a more complete understanding.



As in Triggered mode, the Read Cycle is started with a Trigger Signal. As in Continuous mode, within the read cycle, the reader acquires images continuously and attempts to decode while the trigger is held on. If it decodes successfully, it sends the data out immediately (or after the Stop signal, depending on user settings). The read cycle ends when the host sends the reader a Stop Trigger signal. It begins the next Read Cycle on the next Start Trigger.

Start Read Cycle

The read cycle starts when the trigger is activated or a Start Command String is received.

Capture Control and Processing

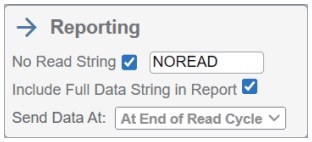
Once received, the read cycle behavior is exactly like continuous mode. It iterates through the Capture List over and over, running all Decode Tools in all Captures until it has a good read. Like for the Triggered Read Cycle described above, a delay can be set between iterations of the Capture list to alleviate processing. The maximum time allowed for each X-Mode instance can be limited as well.

End Read Cycle

The cycle ends when the trigger is deactivated or when a Stop Command String is received. If any Decode Tools have not completed successfully (qualified) by this time, they are shut down and marked as no reads.

Reporting

This section determines how the output string is composed, if it should be sent, and when to send it.



No Read String – If checked, the text from the No Read String text box will be used as the string for any Decode Tools that have failed.

Include Full Data String in Report – By default, the final output string is transmitted out all TCP/IP and RS-232 ports that are enabled. When this option is unchecked, the string is not sent.

Note 1: This setting does not affect PLC based communication. The output string is always set into the PLC Input Assembly at the end of each Read Cycle.

Note 2: This setting also does not affect Digital Outputs. The digital outputs will always be set at the end of the Read Cycle to reflect the current read cycle status.

Send Data At – This controls when the read data is sent.

- **At End of the Read Cycle** – This is the default behavior. The data string is sent at the end of the read cycle.
- **As Data is Decoded** – If this is set, the reader will send the string data to the host immediately, but will not set Pass/Fail or End of Cycle digital outputs until the Trigger is deactivated, or the Stop String is received. In Start/Stop mode the user may choose this option to tell the host that the cycle is complete, and they can issue the stop command sooner than expected.

Start/Stop Read Cycle Settings

Item	Setting value [Job Default]	Description
Start Read Cycle		
Input:	**[Input1 - Trigger]**	Digital Input 1 is the dedicated Trigger Input. The Start/Stop cycles starts when the Input is Activated.
Start Command String	Any String, **[S]**	Serial string used to Start the read cycle when commanded by RS-232 or Socket. Note: Non printable characters are not allowed, with the exception of space. Here, the user must type in an actual space with space bar. This will be displayed as <SP>.
Trigger Delay (msec)	[0]-1,000	Trigger Delay (msec) is used to hold off acquisition for a fixed time after the trigger is received. This allows the user to programmatically align the part in the field of view without having to go onto the line and change the physical trigger location.
Capture Control		
Delay Between Iterations (msec)	0-10,000 **[45]**	Delay inserted between running iterations of the full image Capture List to allow processing to keep up with image acquisition. No delay is inserted between individual Captures within the list. They run back to back.
Processing		
Processing – Max Allotted Time Per Tools (msec)	0-10,000 **[500]**	This parameter sets the maximum amount of time that any instance of the X-Mode decoder will be allowed to run. If X-Mode has not decoded within this amount of time, that X-Mode processing thread will be shut down.
End Read Cycle		
Stop Command String	Any String, **[E]**	Serial string used to stop the cycle when commanded by RS-232 or Socket. Note that falling edge of Input 1 Trigger will stop cycle if Trigger was used to start the cycle. Note 1: The end command must be different from the start command. Note 2: Non printable characters are not allowed, with the exception of space. Here, the user must type in an actual space with space bar. This will be displayed as <SP>.
Reporting		
No Read String	Unchecked,**[Checked]** and string to send **[NOREAD]**	Controls what is output for Decode Tools that fail to Read. By default the string is set to NOREAD.

Item	Setting value [Job Default]	Description
Include Full Data String In Report	Unchecked, **[Checked]**	By default, the final output string is transmitted out all TCP/IP and RS-232 ports that are enabled When this option is unchecked, the string is not sent. Note 1: This setting does not affect PLC based communication. The output string is always set into the PLC Input Assembly at the end of each Read Cycle. Note 2: This setting also does not affect Digital Outputs. The digital outputs will always be set at the end of the Read Cycle to reflect the current read cycle status.
Send Data String	**[At End of Read Cycle]**, As Data is Decoded	Determines timing for sending out Format Output string from Read Cycle. Either it sends it when it receives the stop signal, or it sends it out as soon as all Decode Tools Qualify.

2-1-5 Timing Charts for Each Trigger Mode

There are two methods for Trigger input.

Trigger Input Method	Overview	Trigger Mode
Triggered	Execute Read when the input on the Parallel TRIG signal is ON.	• Triggered • Start / Stop
Continuous Read	With no Parallel TRIG signal used, the code reader executes Continuous Read.	• Continuous • Presentation

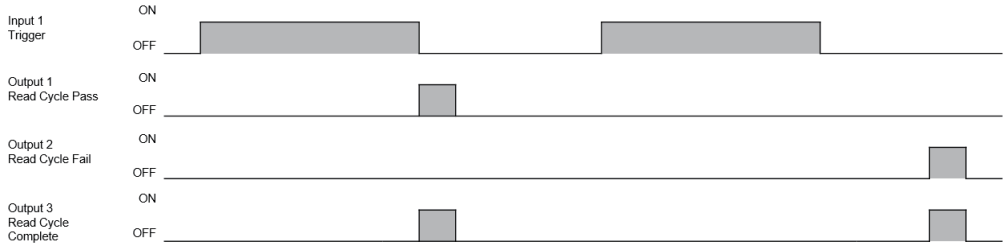
Below is an output assignment example and timing chart for a triggered read cycle.
[Example assignment of OUTPUT signals]

- Output 1: Read Cycle Pass
  This output is ON when all codes were found, all codes were the correct type, and all were read and matched (i.e. contained the correct string content).
- Output 2: Read Cycle Fail
  This output will be ON at the end of read cycle when either not all codes were code present, were not of the correct type, or did not read or match (did not contain the correct string content).
- Output 3: Read Cycle Complete
  Output is ON when the read cycle completes.

	Output 1	Output 2	Output 3
Read Cycle Complete	☐	☐	☑
Read Cycle Pass	☑	☐	☐
Read Cycle Fail	☐	☑	☐
Error Signals			
Output Configuration			
Normal State	Open	Open	Open
Mode	Pulsed	Pulsed	Pulsed
Pulse On Time	5000 µs	5000 µs	5000 µs
Pulse Off Time	5000 µs	5000 µs	5000 µs

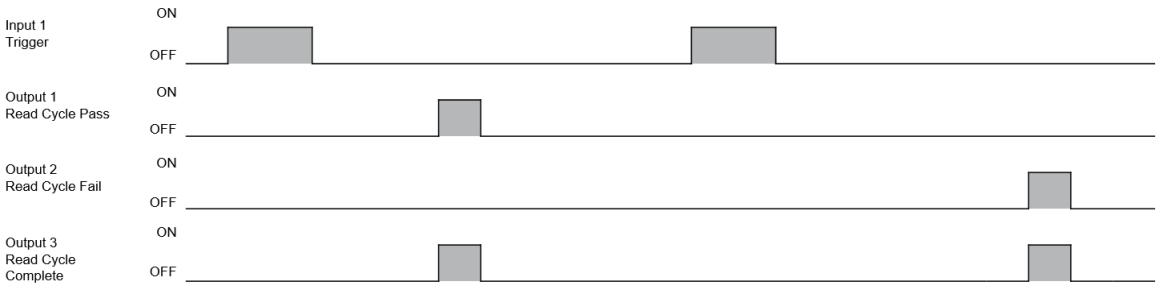
For how to set up the Output signal assignments, please refer to *2-1-7 Change the Assignments for the Output Signal (Output 1 to 3) ON Condition* on page 2-24.

<Timing Chart (Start / Stop)>

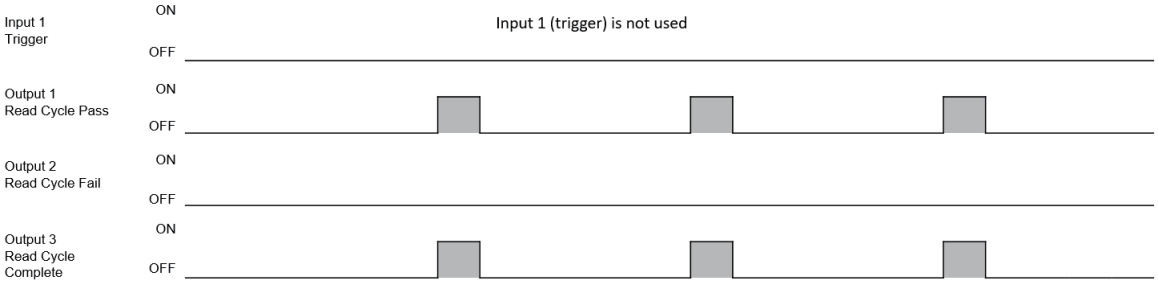


On a Read Cycle Fail there is an increased delay between Input 1 (trigger) changing to OFF and when Read Cycle Fail changes and Read Cycle Complete to ON. This delay is dependent on the decoding time to process the remaining image.

<Timing Chart (Triggered)>



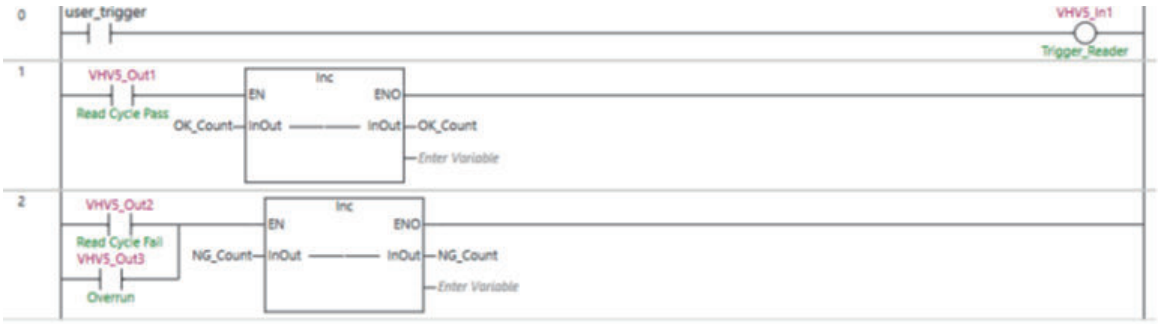
<Timing Chart (Continuous / Presentation)>



*1 Output 1 turns OFF for about 300 µs at the end of each Read Cycle.

2-1-6 Sample Ladder Program

This is a sample ladder program where setting the variable user_trigger = TRUE will execute a Triggered Read on the VHV5-F reader.



Rung	Description
0	Trigger reader – Triggers on the rising edge of user_trigger.
1	VHV5_Out1 is TRUE when read cycle is complete and passes, increment OK_Count
2	VHV5_Out2 is TRUE when read cycle is complete and fails OR VHV5_Out3 is TRUE in an overrun condition where the trigger cycle was too short and a read cycle could not occur. If either condition is TRUE, increment NG_Count

PLC Inputs

Unit1	NX-ID5142-1							
	Input Bit 16 bits	Input bit (16 bits)	R	WORD				
	Input Bit 00	Input Bit 00	R	BOOL	VHV5_Out1		Global Variables	
	Input Bit 01	Input Bit 01	R	BOOL	VHV5_Out2		Global Variables	
	Input Bit 02	Input Bit 02	R	BOOL	VHV5_Out3		Global Variables	

PLC Outputs

Unit2	NX-OD4121						
	Output Bit 8 bits	Output Bit (8 bits)	W	BYTE			
	Output Bit 00	Output Bit 00	W	BOOL	VHV5_In1		Global Variables

VHV5-F Digital Output Assignments

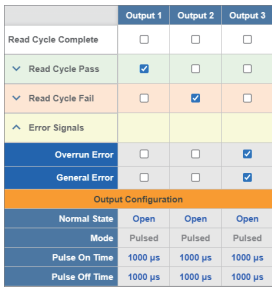
	Output 1	Output 2	Output 3
Read Cycle Complete	☐	☐	☐
Read Cycle Pass	☑	☐	☐
Read Cycle Fail	☐	☑	☐
Error Signals			
Overrun Error	☐	☐	☑
General Error	☐	☐	☐
Output Configuration			
Normal State	Open	Open	Open
Mode	Pulsed	Pulsed	Pulsed
Pulse On Time	5000 µs	5000 µs	5000 µs
Pulse Off Time	5000 µs	5000 µs	5000 µs

Output 1 = Read Cycle Pass
Output 2 = Read Cycle Fail
Output 3 = Overrun Error

For how to set up the Output signal assignments, please refer to *2-1-7 Change the Assignments for the Output Signal (Output 1 to 3) ON Condition* on page 2-24.

2-1-7 Change the Assignments for the Output Signal (Output 1 to 3) ON Condition

Setting up Digital Outputs



Using Digital Outputs to Signal Read Cycle Result Status

The reader has three digital outputs (Output 1 - 3) that can be used to provide detailed Read Cycle Pass/Fail information, as well as Reader Error information to an external host system.

Digital Output Mode of Operation

The three Digital Outputs operate in Pulsed Mode. They will activate (turn on) at end of each Read Cycle to reflect the Read Cycle status. The outputs will be held on for a user to set Pulse On Time, and then will be held off for a user to set Pulse Off Time.

Key Point: The total Pulse On Time and Pulse Off Time will extend the length of the Read Cycle by that combined amount. Setting these values longer than necessary for the host to see the pulse can result in higher Read Cycle times than may be necessary. The default on and off pulse times are 1000 usec. This will add 2 msec to the Read Cycle time.

Digital Output Normal State

The normal (not activated or off) state of each output can be set to Normally Open or Normally Closed.

Digital Output Setting Logic

There are multiple check boxes under each Output that give the user a wide range control over how and why that Output will be set. One or more signals can be assigned to the same Output line. If any of the selected states are true, the output line will be activated. **Example:** In the diagram above, both Overrun and General Error are selected under Output 3. If either of these errors occur, the Output will fire. The Output follows OR logic.

Default Digital Output Settings

The default settings should be adequate for most applications. They provide a pulsed Pass, Fail, and Error signal at the end of each Read Cycle.

- Output 1 – Read Cycle Pass
- Output 2 – Read Cycle Fail
- Output 3 – Error Signals - Read Cycle Trigger and Processing Overrun Error, and General Reader Error.
- Operation
  - Normally Open
  - Pulsed Mode
  - Pulse On and Off Time – 1000 usec (1 msec)

Alternate Digital Output Signaling Strategies

The default output setting indicates Read Cycle pass/fail, as well as any error that has occurred for each Read Cycle. The outputs can be configured differently than the default to give finer detail for each step in the read cycle as well as the exact error type. Clicking on the down arrows next to Pass Signals, Failed Signal, and Error opens up the Output dialog menu to show the detailed settings.

Positive Logic Example: This example shows, using Positive Logic, a deeper look into what passed or failed in the Read Cycle.

Output1 is set to indicate that all the codes were found, meaning that a code of the correct type was found within the Decode Tool region of interest.

Output2 indicates that not only were the codes found, but they passed the Read Qualification stage, which confirms that the code contained required data content. For example, a code was found that started with ABC.

Output3 is set to indicate that not only were codes present, and passed Read Qualification, they passed the full String Matching test as well.

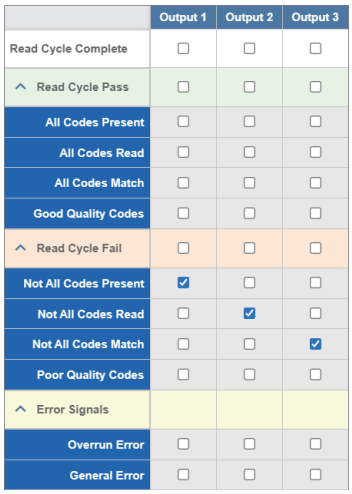
	Output 1	Output 2	Output 3
Read Cycle Complete	☐	☐	☐
^ Read Cycle Pass	☐	☐	☐
All Codes Present	☑	☐	☐
All Codes Read	☐	☑	☐
All Codes Match	☐	☐	☑
Good Quality Codes	☐	☐	☐
^ Read Cycle Fail	☐	☐	☐
Not All Codes Present	☐	☐	☐
Not All Codes Read	☐	☐	☐
Not All Codes Match	☐	☐	☐
Poor Quality Codes	☐	☐	☐
^ Error Signals			
Overrun Error	☐	☐	☐
General Error	☐	☐	☐

Negative Logic Example: This example shows, using Negative Logic, a deeper look into what passed or failed in the Read Cycle.

Output1 is set to indicate that at least one of the target codes was not found.

Output2 is set to indicate that at least one of the found codes failed the Read Qualification. For example, none of the codes found started with ABC.

Output3 is set to indicate that at least one of the codes found and qualified ultimately failed String Matching.



Digital Output Mode of Operation

Item	Setting value [Job Default]	Description
Normal State	**[Normally Open],** Normally Closed	
Mode	**[Pulsed]**	Pulsed Mode. Output will be set on, and then set off according to the Pulse On and Off time.
Pulse On Time (usec)	0 – 10,000,000 (10 sec) [1000]	Amount of time the Output Pulse is set to Active (On) state.
Pulse Off Time (usec)	0 – 10,000,000 (10 sec) [1000]	Amount of time the Output Pulse is set to Off state.

High-Level Output States

Item	Setting value [Job Default]	Description
Read Cycle Complete	**[Unchecked],** Checked	Read Cycle complete is Pulsed or Latched after Read Cycle Data has been transmitted.
Read Cycle Pass	Unchecked, **[Checked]**	Read Cycle Pass – This high level pass signal means the all codes were found, all codes were the correct type, and all were read and matched (i.e. contained the correct string content)
Read Cycle Fail	Unchecked, **[Checked]**	Read Cycle Fail – This high level fail signal means that either not all codes were code present, were not of the correct type, or did not read or match (did not contain the correct string content)

Detailed (Positive Logic) Output States

Item	Setting value [Job Default]	Description
All Codes Present	**[Unchecked],** Checked	All Codes Present – Means that all Decode Tools in the job have found a code of the correct type in the designated search ROIs.
All Codes Read	**[Unchecked],** Checked	All Codes Read – Means that all Decode Tools in the job have found a code that contains the correct identifying data content. (Example:Starts with ABC)
All Codes Match	**[Unchecked],** Checked	All Codes Match – Means that all Decode Tools in the job have fully matched the required data content. (Example: Two codes are found that start with ABC, but full match indicates the target code is the one that ends with 123.) ***Key Point:*** The Match function will drive the reader to continue searching until it finds the full matching code if it exists. It will not stop decoding on the first code found that has been read.
Good Quality Codes	**[Unchecked],** Checked	Good Quality Codes – Means that for all Decode tools where Verification is enabled, the codes all pass. Note: If the Decode Tools does not find the “qualified” code, it will not do Verification.

Detailed (Negative Logic) Output States

Item	Setting value [Job Default]	Description
Not All Codes Present	**[Unchecked],** Checked	Not All Codes Present – At least one Decode Tool has not found a code in its search area of the correct type.
Not All Codes Read	**[Unchecked],** Checked	Not All Codes Read – At least one Decode Tool has not found a code that has the correct identifying data content.
Not All Codes Match	**[Unchecked],** Checked	Not All Codes Match - At least one Decode Tool has not Matched.
Poor Quality Codes	**[Unchecked],** Checked	Poor Quality Codes – At least one Decode Tool is of poor quality and failed Verification.

Error Signals

Item	Setting value [Job Default]	Description
Overrun Error	Unchecked**, [Checked]**	Overrun Errors can be either Trigger or Processing Overrun Errors A Trigger Overrun indicates that a new trigger has been received before the last image was completed A Processing Overrun indicates that triggers are occurring a rate that is faster than the reader can process images. Once the reader runs out of image buffers, it issues the processing overrun signal.
General Error	Unchecked**, [Checked]**	General Error – This indicates and subsystem fault that has occurred with the camera such as a sensor or communication fault.

Use as Ext. Illumination Strobe (Output 3 Signal Only)

Connect External Light (Optional)

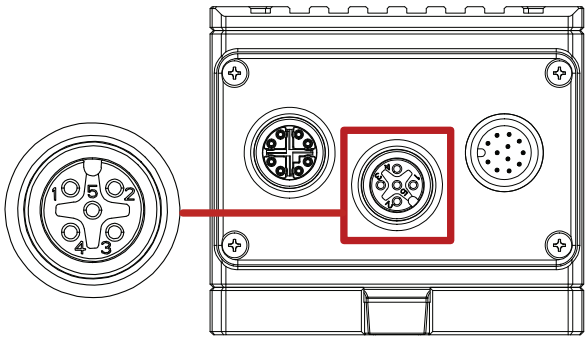
Note: The external light can only be used when the reader is powered via Direct 24V, not PoE.

External Light Port

The third connector on the VHV5-F is used to drive an external light. The 5-pin female M12 provides 24V power, a Strobe Trigger output signal, and an optional Analog Intensity Control output signal. This five-pin assignment is compatible with many common machine vision light vendor's input connector requirements.

Precautions for Correct Use

The user must check the power and wiring specifications for their choice of external light and only connect the relevant signals. For example, pins 4 and 3 would be used to provide just a 24V strobe trigger signal output to an external strobe controller.



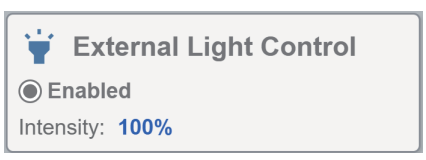
Pin	Signal	Description
1	+24 VDC	Provides up to 1.5 amps of current to light at 24V
2	Strobe Trig –	Strobe Trigger – (NPN referenced to DC Ground)
3	DC Ground	Ground
4	Strobe Trig +	Strobe Trigger + (PNP referenced to 24VDC Ground)
5	Analog Out	Selectable 0-10V analog output for intensity control

Examples:

- NERLITE Smart Series light with built-in strobe controller.
- Smart Vision lights with NanoDrive™ or Multi-Drive™ light control.

External Light Enable

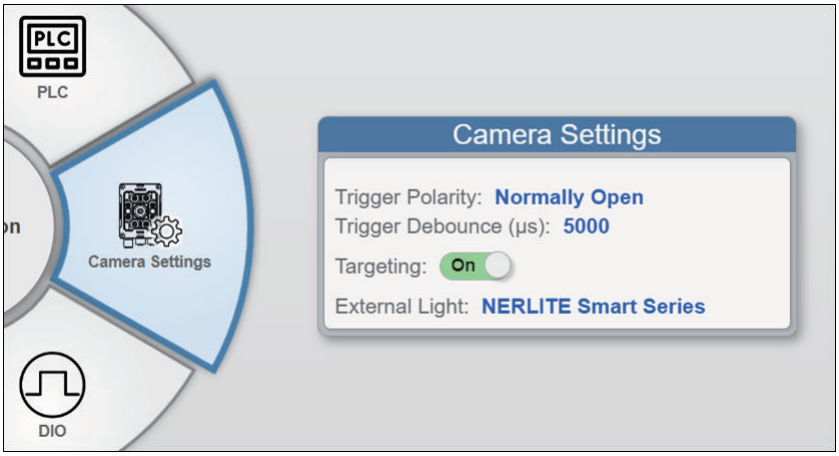
To use the External Light for a capture, it must be enabled in the Capture Settings dialog for that capture. A single capture cannot use both internal and external light at the same time. The Enable control acts like a radio button, turning off internal illumination. It is acceptable, however, to have captures that use internal light and others that use external light mixed in the same job.



Intensity Control

Intensity Control is accomplished through a variable analog voltage output set on Pin 5. Each light vendor may have different voltage limits for intensity, so the user must select the proper vendor from

the list in the Camera Settings dialog on the Device Page. This will limit the analog voltage output range that controls intensity to be compatible with that vendor's light. Pin 5 is set to 0V by default so this connector can be used to drive any external light that requires just power and strobe, or just strobe.



External Light Wiring Notes

Note 1: Pin 2 is a sinking circuit (NPN). It provides a current-limited connection to ground when active and will float when not active. NPN requires an external 24VDC pullup for correct function.

Note 2: Pin 4 is a sourcing circuit (PNP). It provides a current-limited connection to 24VDC when active and will float when not active. PNP requires an external 24VDC pulldown for correct function.

Note 3: Both the PNP and NPN are non-isolated and reference to the same Power/GND as the M12 connector on the reader.

Note 4: NPN/PNP only function when the VHV5-F is connected to a 24VDC power supply (not PoE).

3

Controlling Operation and Data Output with Ethernet

3-1 Controlling Operation and Data Output with EtherNet/IP

3-1-1 EtherNet/IP Overview

EtherNet/IP is an industrial multi-vendor network that uses Ethernet. The EtherNet/IP specifications are open standards managed by the ODVA (Open DeviceNet Vendor Association). EtherNet/IP is used by a wide range of industrial devices.
Because EtherNet/IP uses standard Ethernet technology, various general-purpose Ethernet devices can be used in the network.
EtherNet/IP has mainly the following features.

- **High-speed, High-capacity Data Exchange through Tag Data Links (Cyclic Communications)**
  The EtherNet/IP protocol supports implicit communications, which allows cyclic communications (called Tag Data Links) with EtherNet/IP devices.

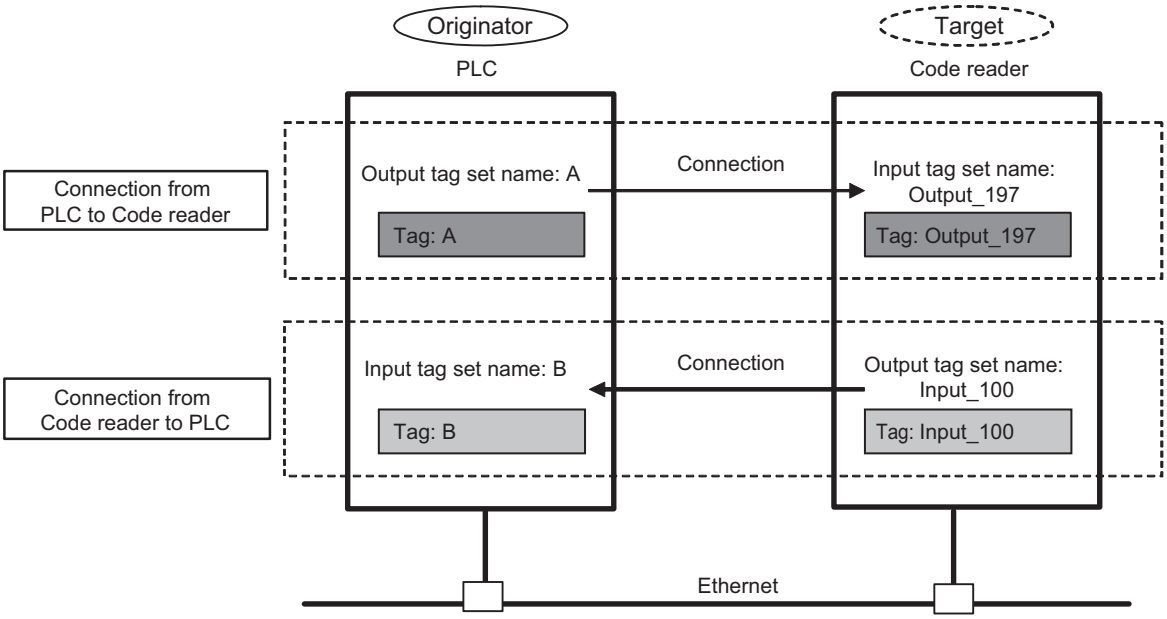
- **Tag Data Links are set at the specified communication cycle for each application regardless of the number of nodes**
  Because the data is exchanged over the network at the refresh cycle that is set for each connection regardless of the number of nodes, that refresh cycle will not increase even if the number of nodes increases. (Data exchange in the connection is kept in synch)
  Because the refresh cycle can be set for each connection, each application can communicate at its ideal refresh cycle. (For example, interprocess interlocks can be transferred at high speed, while the production commands and the status monitor information are transferred at low speed.)

Precautions for Correct Use

On a network to which many devices are connected, performance may drop (e.g., responses may be delayed or packets lost) or communications errors may occur when there is temporarily high traffic on the network.
Test the operation under actual conditions before you start actual operation of the system.

Data Exchange with EtherNet/IP (Implicit Communications)

Data is exchanged cyclically between Ethernet devices on the EtherNet/IP network using Tag Data Links as shown below.



- **Data Exchange Method**
  To exchange data, a connection is opened between two EtherNet/IP devices.
  One of the nodes requests the connection to open a connection with a remote node.
  The node that requests the connection is called the *Originator* and the node that receives the request is called the *Target*.

- **Data Exchange Memory Locations**
  The memory locations that are used to exchange data across a connection are specified as tags.
  You can specify memory addresses or variables for tags.
  A group of tags consists of an output tag set and an input tag set.

3-1-2 Communication with the Code Reader over EtherNet/IP Connection

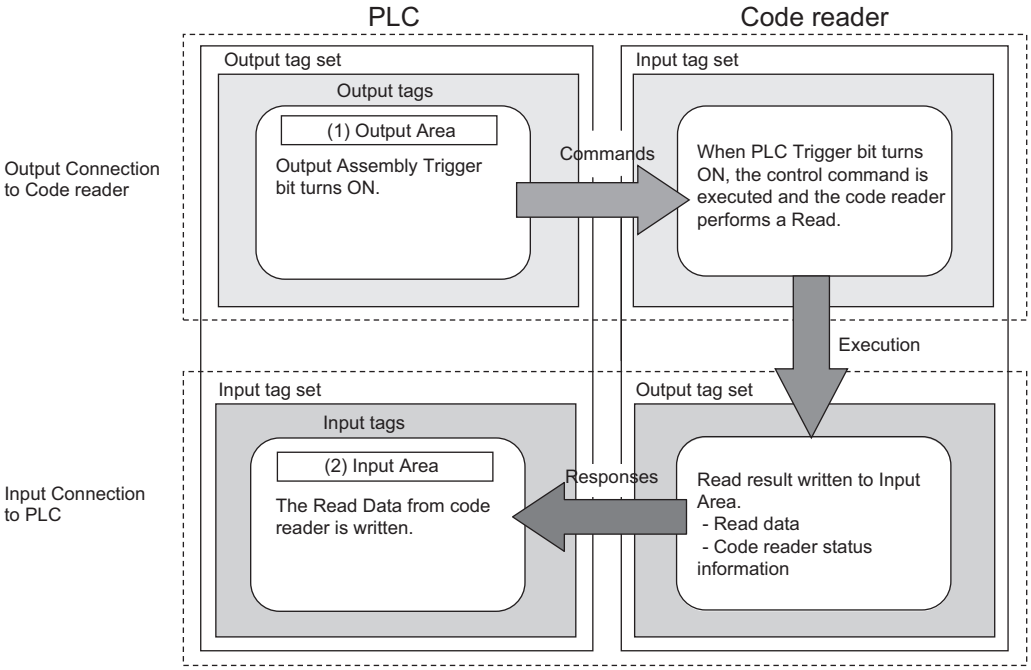
You can use an EtherNet/IP Tag Data Link to communicate between the PLC and the code reader.
The PLC can control the code reader with Command/Response communications and the code reader can output data after executing a Read.
To connect to OMRON Controllers and communicate through EtherNet/IP, you can use Sysmac Studio, or Network Configurator to set up the Tag Data Links (tags, tag sets, and connection settings).
For more detailed information on Tag Data Link settings, please refer to the following manuals.

- *NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual (Cat. No. W506)*
- *CS/CJ-series EtherNet/IP Units Operation Manual (Cat. No. W465)*
- *CJ-series EtherNet/IP Units Operation Manual for NJ-series CPU Unit (Cat. No. W495)*

Function Blocks Library and Sample Program for Omron Controllers are available for download.
Please, visit Omron website for Function Blocks Library and Sample Program for additional PLC / Controllers.

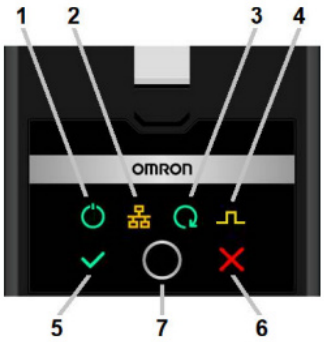
Types of Communication Areas

For EtherNet/IP, communication with a PLC, the communication is performed using two communication areas on the PLC, the Input Field and the Output Field. This code reader has one type of Input Field Assembly and one type of Output Field Assembly.



3-1-3 VHV5-F Communication Settings (EtherNet/IP)

The round button (7) between the green checkmark and the red x will reset the IP address to 192.168.188.2 subnet 255.255.0.0. You can skip this step if you know the VHV5-F IP address or plan on using the DDU (Device Discovery Utility) software to set the IP address.

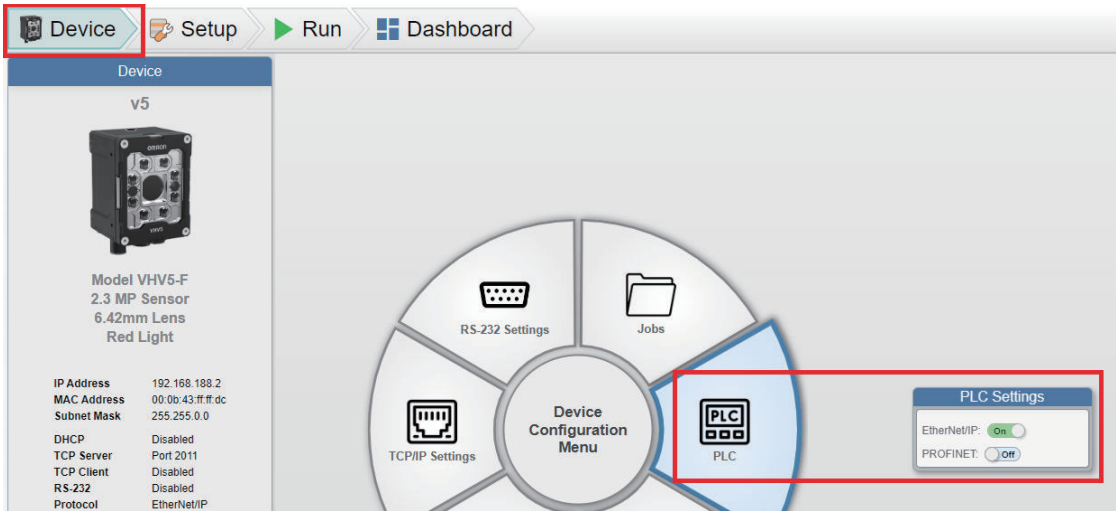


DDU (Device Discovery Utility)

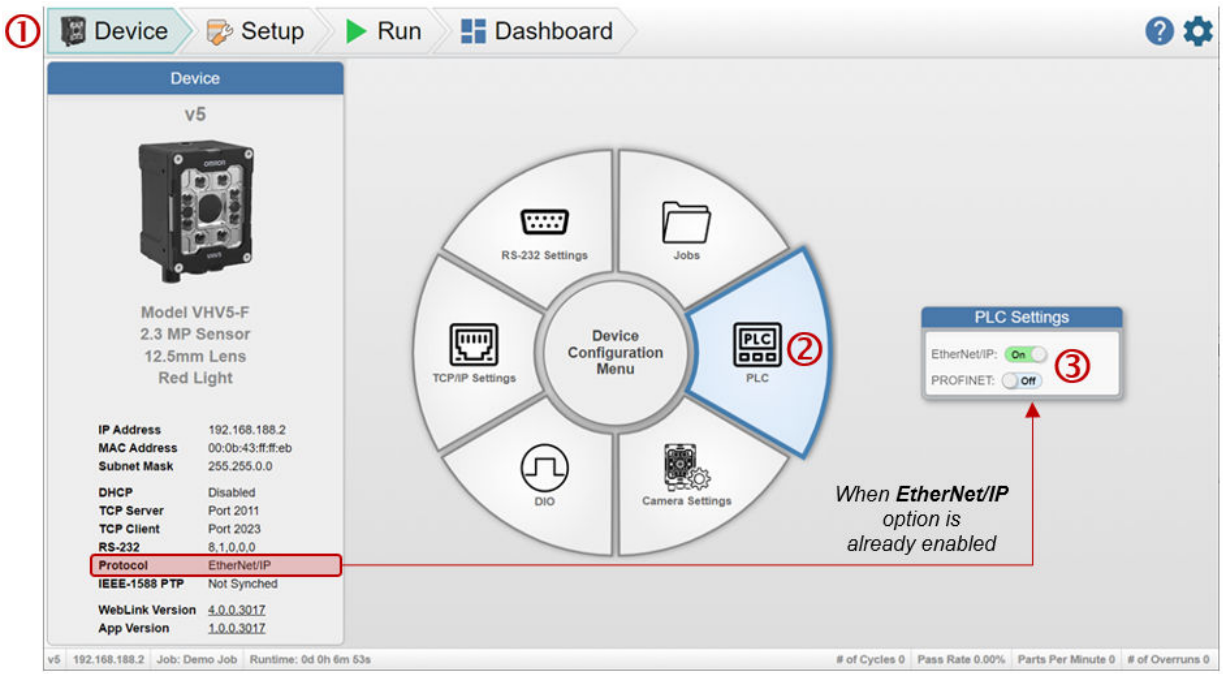
Used to set a preferred IP address.

WebLink

Used to enable the EtherNet/IP option under the PLC menu.



3-1-4 Enabling PLC Communications (EtherNet/IP)



The **Device** view shows the current status and settings of the reader in the left-hand pane. The Rotary Device Configuration Menu in the middle is used to set up communication, industrial protocols, and

other unique camera settings. When menu items are selected, settings dialogs appear to the right of the menu wheel. If a parameter is changed, the user will be prompted to Apply the settings.

1. Select the **Device** view in WebLink.
2. Select **PLC** option on Rotary Device Configuration Menu.
3. Enable **EtherNet/IP** option on PLC settings dialog (if not enabled yet).
4. Click on **Apply Changes** button to confirm the selection (only available if **EtherNet/IP** option has just been enabled).

Please refer to "Enabling PLC Communications" in the *Autofocus Multicode Reader VHV5-F Series User Manual (Z476-E (84-9000xxx-xx))*.

3-1-5 Tag Data Link Setting Methods

This section describes how to set data links for EtherNet/IP.
The communications areas in the PLC for which data links to the code reader are created and specified as tags and tag sets, and the connections are set for tag data link communications.

Precautions for Correct Use

When connecting to an NJ/NX-series or CJ-series CPU Unit, install the EDS file that defines the connection information for the code reader in to Sysmac Studio.
Download the EDS file from OMRON's website.

Tags, Tag Sets, and Connection Settings

The code reader has one type of Input Assembly and one type of Output Assembly
For more detailed information about Memory Allocation and the Data Structure of each Assembly, please refer to *A-2 EtherNet/IP Specifications* on page A-3.

Assemblies

Assembly Name	Connection I/O Type	Input/ Output	Assembly ID	Size (bytes)	Assembly Description	Data Structure
Input Assembly	Input_Output	Input	100	492	Holds symbol information and read result information for all of the barcodes that were read. Holds 440 bytes of read data.	*1
Output Assembly	Input_Output	Output	197	284	Commands for read cycle, job, and reader controls can be sent to the code reader.	

*1. Refer to *A-2 EtherNet/IP Specifications* on page A-3.

Tag Set Settings

Setting Item	Setting
Input	
Tag Set Name	Tag Set Name on PLC
Size	492 Bytes

Setting Item	Setting
Output	
Tag Set Name	Tag Set Name on PLC
Size	284 bytes

Connection Settings

Setting Item	Setting
Input	
Assembly ID	100
Size	492 bytes
Originator Variable	Variable defined on the PLC
Size	492 bytes
Connection Type	Point to Point connection
RPI	8.0 to 65.0 ms (Default: 20.0 ms)
Timeout	RPI × (4 to 512) (Default: RPI × 4; Timeout must be greater than 10ms)
Output	
Assembly ID	197
Size	284 bytes
Originator Variable	Variable defined on the PLC
Size	284 bytes
Connection Type	Point to Point connection

Precautions for Correct Use

- If I/O memory addresses are specified for the communications areas, the information in the communications areas will be cleared when the operating mode of the PLC changes unless addresses in the CIO Area, which hold memory, are specified.
- The following Assembly objects are required to specify instances when the EDS file is not used.

Setting the Assembly Object

Setting Item	Setting Value	Note
InstanceID	100	Input Assembly
	197	Output Assembly

For information on the PLC data types and variables used to communicate via EtherNet/IP with the VHV5-F Code Reader, see *A-4 Accessing Controller (PLC/MAC) Communication Areas using Variables* on page A-15.

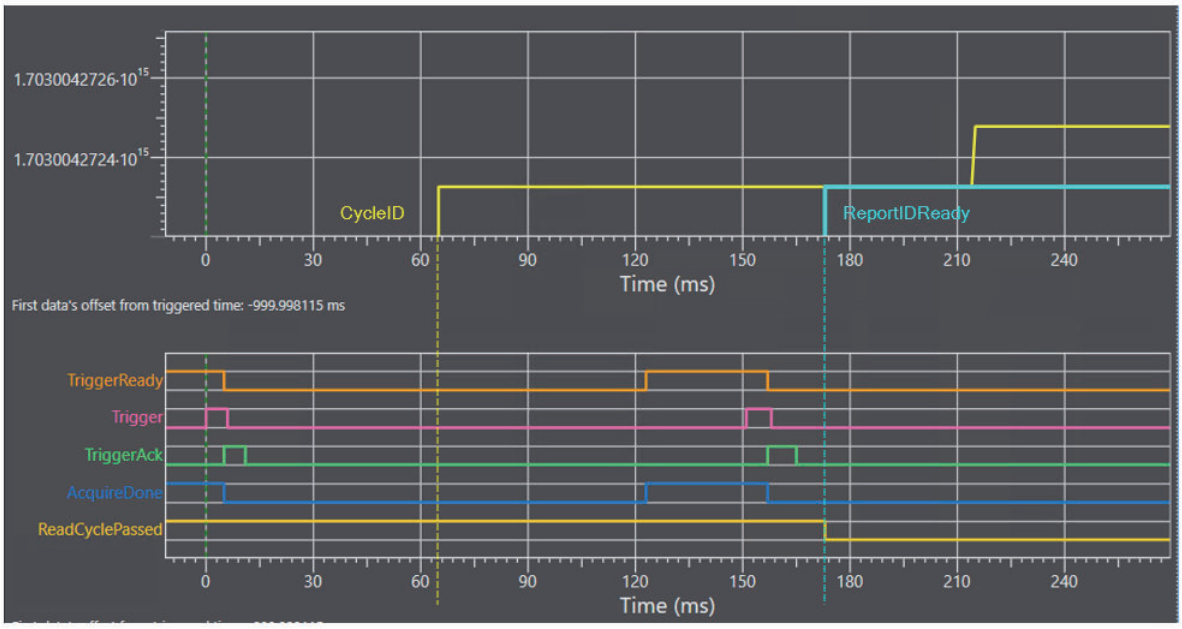
3-1-6 Timing Chart

Read is Executed by the Read (Trigger) Signal

● Timing Chart

■ Timing Chart Description

VHV5-F Input (100)



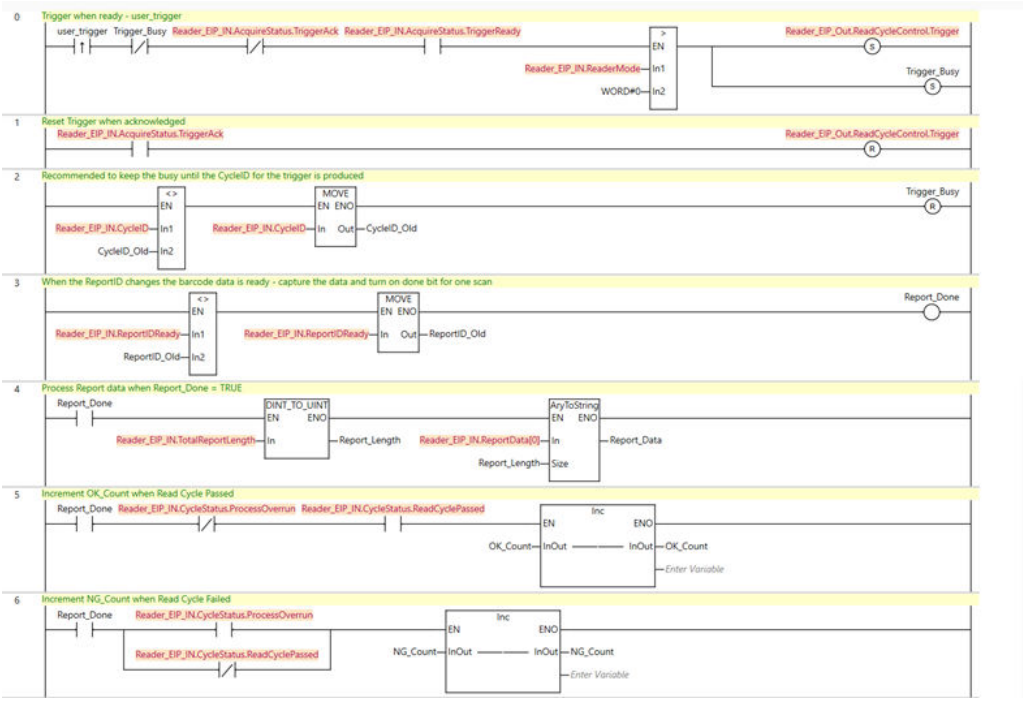
1. Rising edge of **Trigger** starts first read cycle. (0 ms)
2. **Trigger Acknowledged** turns ON when Trigger ON is detected and turns OFF when Trigger OFF is detected. (5 ms)
3. **Acquisition Done** and **Trigger Ready** turn OFF during the image capture(s). (5 ms) If the reader is configured for multiple image captures, these signals could turn ON depending on the delay between captures and will turn OFF at the start of the subsequent capture. Two Captures are shown in the example above.
4. The **Cycle ID** value changes indicating that Decoding has started on the first image capture. (66 ms)
5. The **Acquisition Done** and **Trigger Ready** turn ON because image captures are completed. (124 ms)
6. Rising edge of **Trigger** starts second read cycle. (152 ms)
7. The **Report ID Ready** value changes to match first Cycle ID indicating that the first read cycle is complete and the read cycle report data is available. (173 ms)
8. **Read Cycle Passed** changed to OFF to indicate that this read cycle failed. (173ms)

3-1-7 Sample Ladder Program

A sample ladder program is shown below.

- Input the Trigger Signal to execute Triggered Read.
- The reader provides a new CycleID at the start of the read cycle.
- The reader provides changes the ReportIDReady to match the CycleID to indicate that the read cycle is complete and results are available.
- Process the Read Cycle Report from the reader.
- On a passed read cycle increment the OK Count, on a failed read cycle increment the NG Count.

In this example, the VHV5-F Input (100) and Output (197) modules are used.



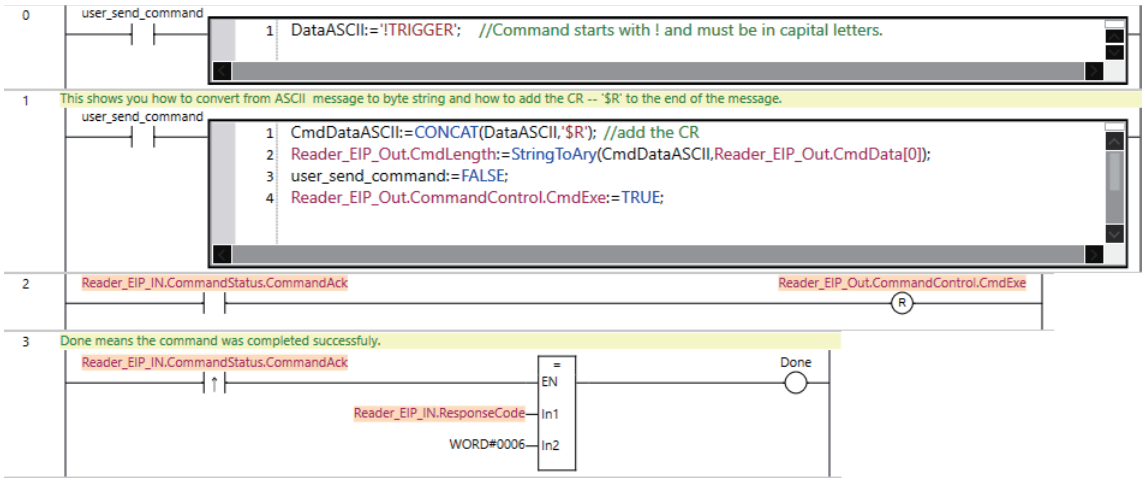
Detailed Review of Ladder Program

Rung	Description
0	Trigger reader – Triggers on the rising edge of user_trigger, if the following conditions are correct. • Trigger_Busy = FALSE • TriggerAck = FALSE • TriggerReady = TRUE • ReaderMode > 0 (reader is in run or setup mode)
1	Reset EIP Trigger when TriggerAck = TRUE
2	Wait for new Cycle ID to indicate start of read cycle • Copy CycleID to CycleID_Old in preparation for next trigger
3	Wait for Report ID to change indicating that a read cycle is completed and read cycle report is available • Copy ReportIDReady to ReportID_Old in preparation for next read cycle report
4	If read cycle report is available (Report_Done = TRUE), copy decoded barcode string to local variable
5	If read cycle report is available (Report_Done = TRUE) and read cycle passed, increment OK_Count
6	If read cycle report is available (Report_Done = TRUE) and read cycle failed, increment NG_Count

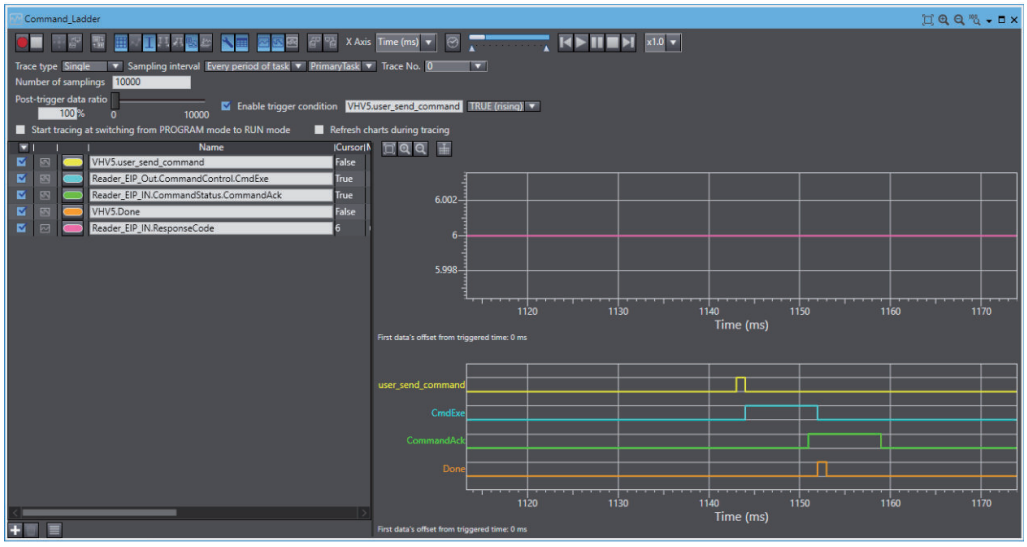
3-1-8 Communicating with the Code Reader with Command Data

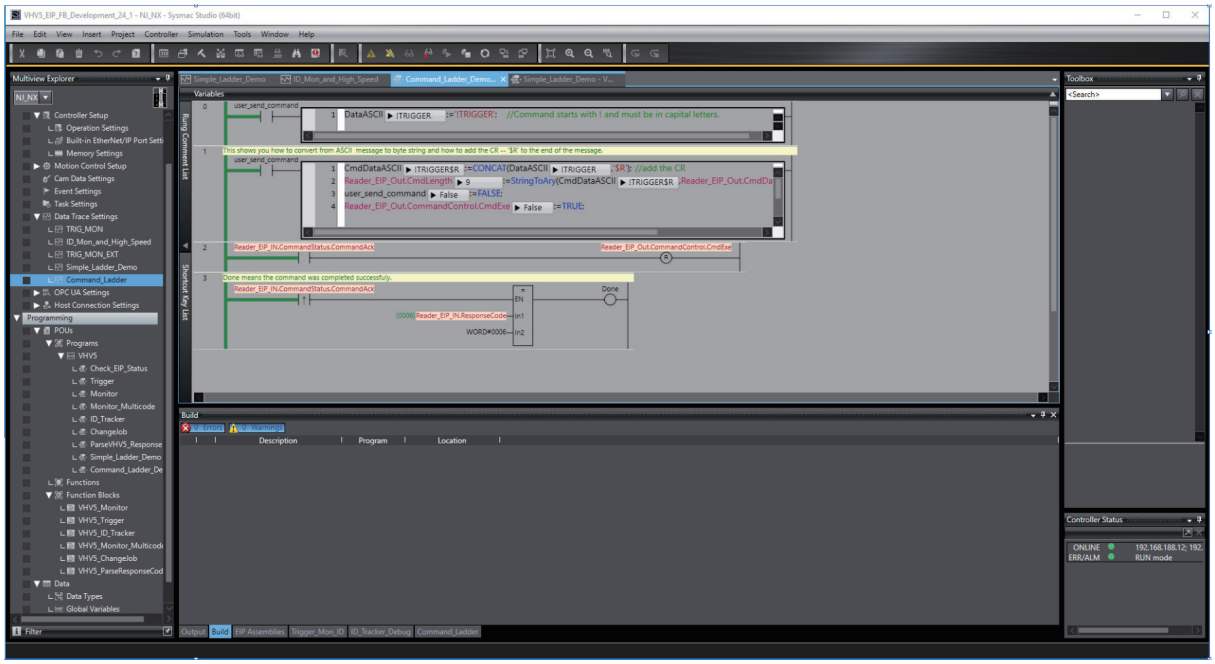
See *A-5 Serial Commands* on page A-24 for more information.

The example below uses a **!TRIGGER** command.



Note: There are no string responses to the commands when commands are sent via EtherNet/IP.





3-2 Controlling Operation and Data Output with Serial (TCP or UDP)

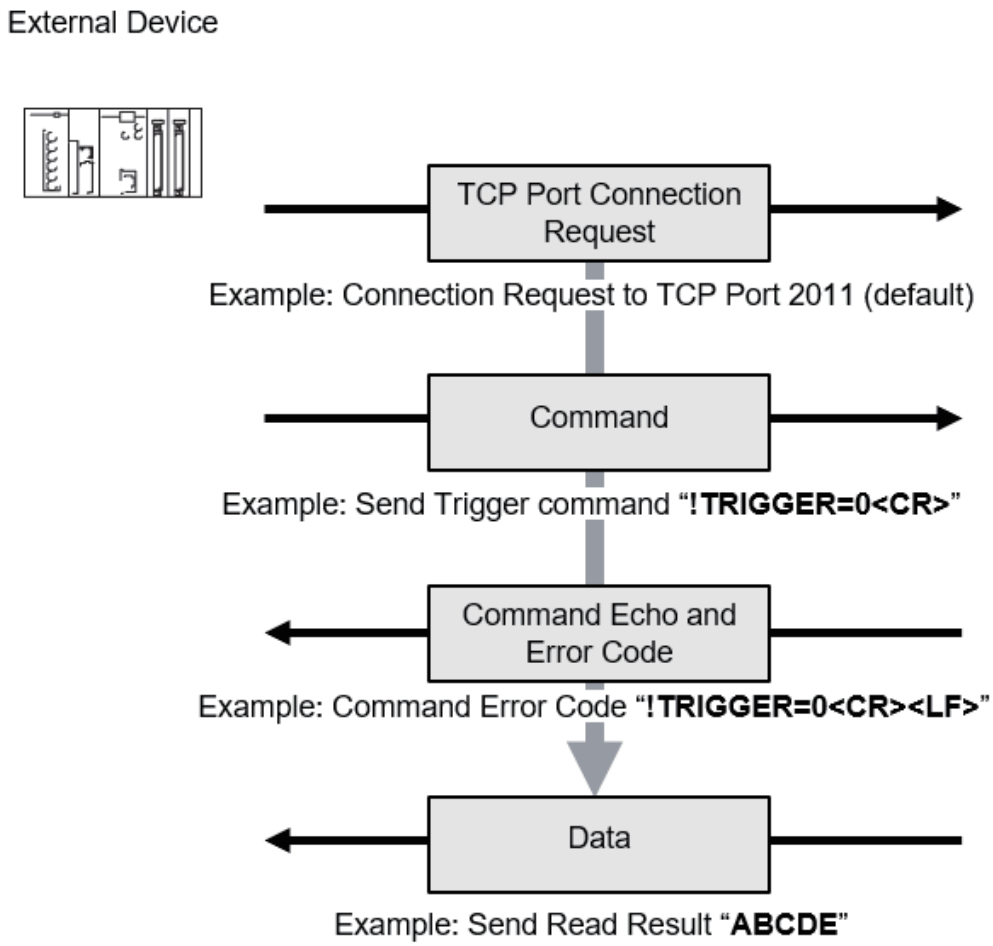
This section explains the communications settings required for using Serial (TCP or UDP) communications between the code reader and an external device.

3-2-1 Serial (TCP) Overview

Serial (TCP or UPD) conforms to the TCP/IP communication protocols. It can be used with any Ethernet communication equipment compatible with TCP/IP communication protocols. The reader can be set up as a TCP Server, TCP Client, UDP Server and UDP Client for maximum flexibility. The channels are not exclusive. Any combination of channels can be set up and will function simultaneously. Each channel operates in parallel with the others. Settings for one do not affect the others.If you intend to use with an Omron PLC, please verify that it supports any of these Socket Services.

3-2-2 Communications Processing Flow

In a system configuration that is connected by Serial communications to an external device (such as PLC), serial commands can be received and code reading results can be output to the external device.
Shown below is the basic flow for establishing the Serial (TCP or UDP) communications, executing a Trigger command and outputting the Read result.

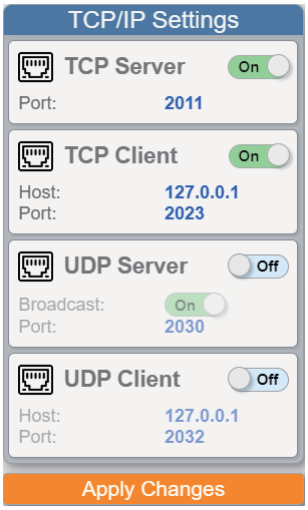


Note: For more information on user commands please reference Appendix A-5 Serial Commands

3-2-3 Communication Settings (Serial (TCP))

TCP/IP Settings Dialog

TCP and UDP communication channels permit the establishment of connections with the reader on any port. The channels can be used for both command input to the reader as well as data output from the reader. The default reader output is the string constructed by the Format Output step in the Read Cycle. This is the same string that is displayed in the UI, as well as the string that is sent over RS-232, and that is sent to the PLC.



The reader can be set up as a TCP Server, TCP Client, UDP Server and UDP Client for maximum flexibility. The channels are not exclusive. Any combination of channels can be set up and will function simultaneously. Each channel operates in parallel with the others. Settings for one do not affect the others.

● Default Settings

By default, the reader operates as a TCP server, and communicates with the host (set up as a TCP client) over TCP/IP for both commands and data. If any setting is changed, the Apply Changes button appears. Settings are effective immediately after Apply.

● TCP Server Implementation

When the reader endpoint is configured as a TCP server, it is able to handle up to 10 simultaneous client connections. For TCP, the reader will refuse the connection when the limit has been reached.

● TCP Client Implementation

This allows the reader endpoint to be configured as a client that can then connect to a host server.

Note: The user must first set up and start an external TCP Server for the reader to be able to connect. The Host IP and Port are the IP and Port of the Server. The reader can only connect to one server at a time.

● UDP Server Implementation

When the reader endpoint is configured as a UDP Server, it is able to handle up to 10 simultaneous connections. For UDP, the reader will simply ignore the connection request due to the connectionless nature of the transport layer. By default, the UDP server will be in “Broadcast” mode, meaning it will send the VHV5-F output data to all devices on its network or subnet. Any devices listening for UDP broadcast data on the same network as the VHV5-F can receive that data. Client UDP devices may send commands to the VHV5-F by specifying its IP and the UDP Server port number (2030 by default). If the Broadcast mode is turned off, then the UDP Server will only communicate with devices that communicate with it first. For example, if a UDP client device were to send the “!TRIGGER” serial command, the VHV5-F would respond to that command by triggering an inspection and it would add the IP of that client to an internal list. All subsequent output data would then be sent to all clients in its list directly via UDP.

● UDP Client Implementation

This allows the reader endpoint to be configured as a UDP Client that can connect to a UDP Server running on the host. The reader can only send data out one UDP port. UDP is limited to UDP/IP in order to avoid broadcasting data on the network.

Note: The user must first set up and start an external UDP Server for the reader to be able to connect. The Host IP and Port are the IP and Port of the Server. The reader can only connect to one server at a time.

When in UDP Client mode, you must specify the IP address and port of the external UDP Server you wish to communicate with. All output will be sent directly to that IP and Port via UDP in a connectionless fashion. The VHV5-F will also listen for incoming commands from the specified IP and Port.

TCP/IP Settings

● TCP Server Settings

Item	Setting value [Job Default]	Description
Port	Any **[2011]**	Client devices connect to the reader using the reader's IP and the Port number set in the dialog. There is no limitation on the port number for the reader, so can be set what is best for client.

● TCP Client Settings

Item	Setting value [Job Default]	Description
Host IP	Any	IP address of host running as TCP Server
Port	Any **[2023]**	The reader will connect to the host server using the IP of the host and Port defined by the host server.

● UDP Server Settings

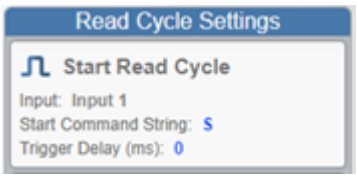
Item	Setting value [Job Default]	Description
Broadcast	Off**, [On]**	If the Broadcast mode is turned on, the reader data will be sent to all devices on its network or subnet. If the Broadcast mode is turned off, then the UDP Server will only communicate with devices that communicate with it first.
Port	Any **[2030]**	Client UDP devices may send commands to the reader by specifying its IP and the UDP Server port number (2030 by default). There is no limitation on the port number for the reader.

● UDP Client Settings

Item	Setting value [Job Default]	Description
Host IP	Any	IP address of host running as UDP Server
Port	Any **[2032**]	The reader will connect to the host server using the IP of the host and Port defined by the host server.

Change the Command that Executes Read

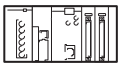
VHV5-F jobs with the Read Cycle set to Triggered or Start/Stop can be triggered serially.
It is possible to change the command used in Serial communications to execute Read. In WebLink – **Setup** view, select **Read Cycle** (left side) and select **Settings** tab (right side). For more information on adjusting Read Cycle Settings, refer to "Read Cycle Settings Dialogs" in the *Autofocus Multicode Reader VHV5-F Series User Manual (Z476-E (84-9000xxx-xx))*.

Setting Item	Setting Value	Description
Start Character	Limited to 1 ASCII printable character or a space (Hex: 20). (Default: S (Hex: 53))	Specifies the command character used to start a Read Cycle. 
Stop Character	Limited to 1 ASCII printable character or a space (Hex: 20). (Default: E (Hex: 45))	*Only Applies to Jobs configured as Start/Stop* Specifies the command character used to end a Read Cycle. This character must be different from the Start Character. 

● Example: Serial Trigger Command

- Read string: 12345, Format Output: Space, Preamble: None, Postamble: \r\n
  Transmit: S
  Response: 12345<CR><LF>

External device



	Serial Trigger
Character notatiion	S
Hex notatiion	53

Code Reader

In Read Cycle	Read result						
Character notatiion	1	2	3	4	5	CR	LF
Hex notatiion	31	32	33	34	35	0D	0A

3-2-4 Decode Tool Output Formatting

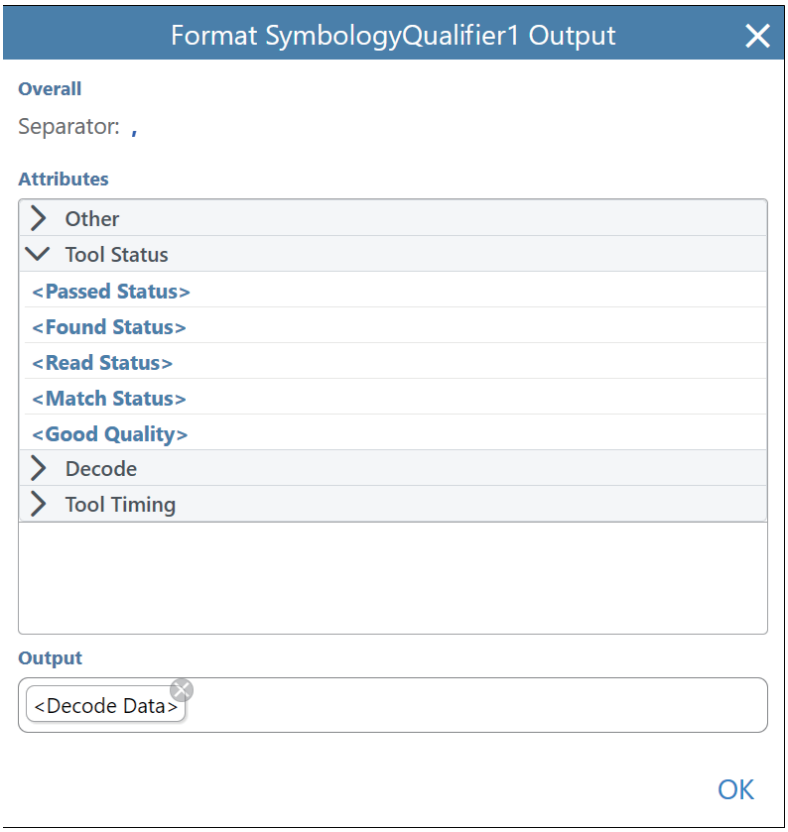
Constructing the Decode Tool Output String

The last function in the Decode Tool is Output. Output is used to compose the data string that is sent out from the Decode Tool to the Read Sequence. Data strings from all Decode Tools are appended into the overall output string result that will be sent at the end of the Read Cycle to the host.

By default, the Output for each Decode Tool contains the <Decode Data> field. <Decode Data> is the string contents of the code that has just been read.

The Formatting Tool described below allows the user to further customize the decode tool output string by adding user text, additional attributes of the code itself such as its X,Y, and Angle, and performance metrics for the Decode Tool such as decode time.

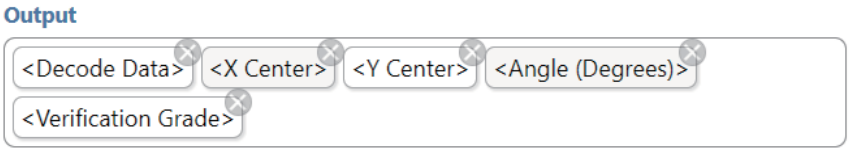
1. Click on <Decode Data> to open up the output string editor. The current content fields of the string are listed in the Output area.



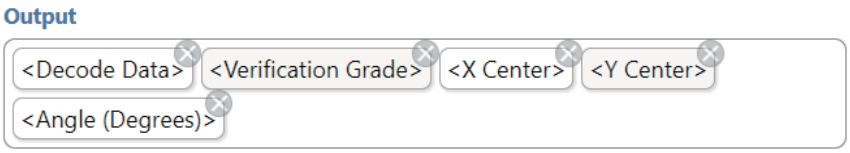
2. Append additional data to the string by clicking the desired attribute in the Other, Tool Status, Decode, or Tool Timing categories. That field will automatically appear at the end of the string in the Output area.

3. A user-defined separator is automatically inserted between each field as it is added.
   Note: There are three exceptions to this. No separator is inserted before or after <User Defined Text>, <SP>, or <TAB>. This allows the user the most control over creating a custom string.
4. The order of the fields in the string can be changed by dragging them to new locations in the field list.
5. Finally,any data field, including <Decode Data>, can be deleted from the Decode Tool Output string by clicking on the X for that field.

Example 1: This example shows what Output would contain if the user chose **Decode Data, X, Y, Angle, and Verification Grade** from the attributes lists.



Example 2: If the user wanted the Verification Grade second in the list instead, they would just click, drag, and drop it between <Decode Data> and <X Center>, producing the following:

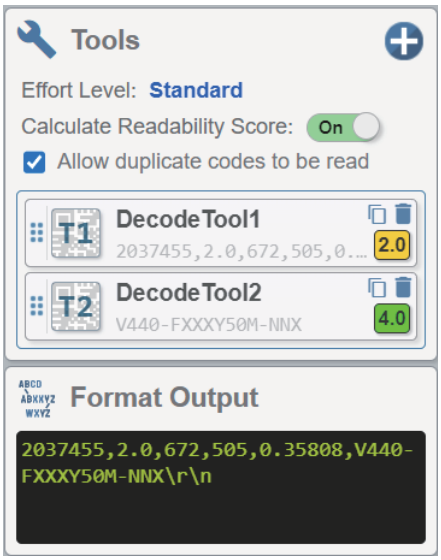


Example 3: This example shows how the <User Defined Text> field is used. Clicking on that field allows the user to change the text. It was changed to “Readability Score" as shown below.

The output from the Decode Tool is now:

```
2037455, Readability Score = 83\r
\n
```

Key Point: All Decode Tool Data Strings are sent up to the Read Sequence where they are automatically appended into the final Read Cycle Output String. The custom string from each Decode Tool can be seen both in the Decode Tool in the Tools Step section, and as part of the final string in the Format Output section.



See the table below for all the data/attributes that can be added into the Decode Tool output string, including User-Defined Text.

Decode Tool Format Output Result Options

Item	Description/Content
Other (User Text and General Text Formatting)	
User Defined Text	String to be inserted by the user
<SP>	Space is inserted
<TAB>	Tab is inserted
Tool Status – Pass fail status of the Decode Tool	
Passed Status	Decode Tool Status. Code was found, read, and matched (if enabled). Passed = **TRUE**. Failed = **FALSE**
Found Status	Found means that a code was found that was one of the target symbology types selected by the user, and it was in one of the ROIs set up by the user. Passed = **TRUE**. Failed = **FALSE**
Read Status	Read means that a code was found, and then it passed the Read Qualification step. Passed = **TRUE**. Failed = **FALSE**
Match Status	Matched means that a code was found, passed the Read Qualification step, and finally that the full string content matched user set match string. Passed = **TRUE**. Failed = **FALSE**
Good Quality	Good Quality means that code qualified completely and passed verification.
Decode Data – Data generated by X-Mode specific to the code that was read.	
Symbology Type	Symbology Type. Data Matrix, Code 93, etc.
Decoded Data String	Actual string date contained in the code
Polarity	Dark on Light = **TRUE**. Light on Dark = **FALSE**

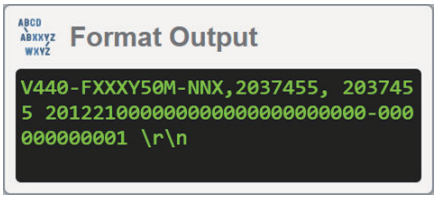
Item	Description/Content
X1, Y1, X2, Y2, X3, Y3, X4, Y4 (pixels)	XY pixel coordinates of the four corners of the code corresponding the green rectangle drawn on the code. 1= Bottom Right, 2 = Bottom Left, 3 = Top Left, 4 = Top Right. Note that relationship stays relative to the angle of the code, not the code on the screen. Coordinate system reference: The upper left corner of the screen is considered 0,0 in pixel coordinates.
Readability Score	Outputs readability score 1-99 using quick test for code quality.
X Center Y Center (pixels)	X, Y coordinates of center of code. Corresponds to green rectangle drawn on the code. Coordinate system reference: The upper left corner of the screen is considered 0,0 in pixel coordinates.
Width, Height (pixels)	Width and Height of Code
Angle (Radians)	Angle of Code in Radians
Angle (Degrees)	Angle of Code in Degrees
Verification Grade	Letter or Number Grade depending on Format Setting A-F or 4.0 – 0.0
Verification Report	Output String with Letter or Number Grades for all verification tests. Overall Grade comes first, Reference Decode Second, and then all other tests as shown in the Verification Grade Display.
Tool Timing	
Time Localize (msec)	Time spent searching for possible locations of the target code in the ROI or Field of View
X-Mode Decode Time (msec)	Time spent evaluating all possible locations to determine if they are in fact a code, and then additional time spent to do the decode.

3-2-5 Read Sequence Data Format Output

Overview

In the next to last step in the Read Cycle, the formatted output string from each Decode Tool is passed to the Read Cycle Format Output step. Here, the final output string is constructed prior to being transmitted out as the final Read Cycle result.

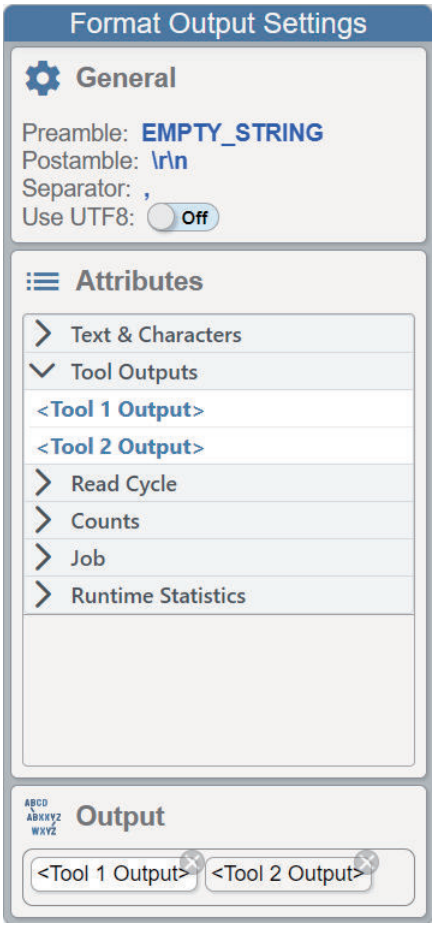
By default, each Decode Tool's string, <Tool Output> is appended into the final result string. The user also has the capability to add user defined text as well as Read Cycle specific data such as Read Time into the final string.



The Format Output Dialog described below allows the user to further customize the final result output string by adding User Text, detailed Pass/Fail data, Counts, Timing and performance metrics for the Read Cycle. Trigger and Result Time Stamps can be added as well.

Read Cycle Format Output Dialog

The user appends additional data to the string by clicking the desired attribute in the Text&Character, Tool Outputs, Read Cycle, Counts, Job and , Runtime Statistics categories. That field will automatically appear at the end of the string in the Output area.

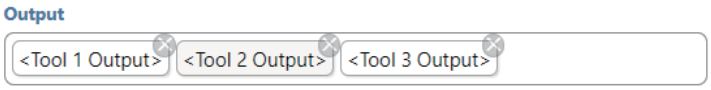


The user can set a predefined Preamble, Postamble and separator which will automatically inserted in the final result string.

The order of the fields in the string can be changed by dragging them to new locations in the field list.

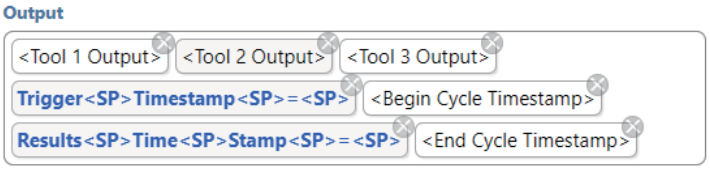
Finally, any piece of data, including <Tool Output>, can be deleted from the Output string by clicking the X for that field.

Example 1: This example shows what final Read Cycle Output would contain by default if the Job contained three Decode Tools.




```
V440-FXXXY50M-NNX,2037455, 2037455 2
012210000000000000000000000-000000000
001 \r\n
```

Example 2: This formatting example shows custom text strings and timestamp data added for that read cycle.




```
V440-FXXXY50M-NNX,2037455, 2037455 2
012210000000000000000000000-000000000
001 ,Trigger Timestamp = ,1699622110
122909,Results Time Stamp = ,1699622
110154002\r\n
```

4

Controlling Operation and Data Output with PROFINET

This section describes the procedures for connecting the VHV5-F Reader to the Programmable Logic Controller / Machine Automation Controller (hereinafter referred to as Controller) via PROFINET IO, and for verifying the device connections. After following the configurations in this section, the user will be able to view PROFINET input and output module data, make changes to the output module, and verify those changes at the input module. The examples in this section do not contain any PLC programming, custom data structures, or setup, beyond connecting the input and output modules. It is the user's responsibility to program the controller once data access to the VHV5-F has been established.

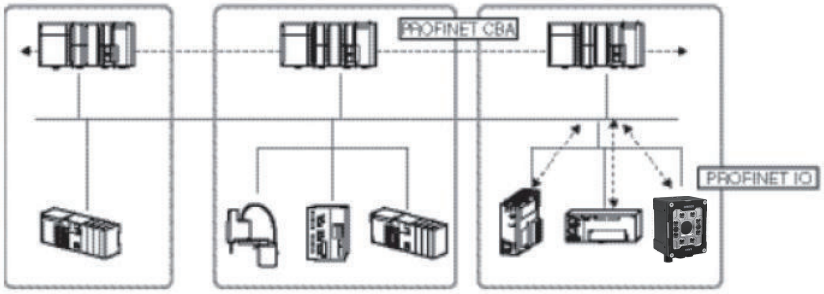
4-1 Overview of PROFINET

PROFINET is a network for industrial use that applies industrial Ethernet (100 Mbps, full duplex) to PROFIBUS DP.
PROFINET is an open standard that is managed by PI (PROFIBUS and PROFINET International) and is used in a variety of types of industrial equipment. Because PROFINET uses standard Ethernet technology, a variety of general-purpose Ethernet devices can be included in the network.
This section provides an overview sufficient to use this code reader with PROFINET.
Refer to the standards IEC61158, IEC61784, and PI for detailed PROFINET specifications.

4-1-1 Types of PROFINET

There are two PROFINET standards: PROFINET CBA and PROFINET IO.

- PROFINET CBA
  Inter-device communication using components. Mainly used between controllers.
- PROFINET IO
  Control by I/O data between a controller and devices.



This code reader supports PROFINET IO. PROFINET IO uses the same device model as PROFINET DP.
The information of each device is described in a GSD (General Station Description) file based on XML (Extensible Markup Language).

Device Types Used in PROFINET IO

The devices below are defined in PROFINET IO.

Type	Details
IO Controller	Controller for external and other devices.
IO Device	Reader device connected to the IO controller. This code reader is an IO device.
IO Supervisor	PC or other device used for maintenance and diagnosis.

IO Devices

IO devices consist of DAPs and IO modules.
The functions and properties of these devices are described in a GSDML file.

- **DAP (Device Access Point)**: This is an Ethernet access point and is used by means of a communication program.
- **IO Module**: Consists of the Slot, Subslot, and Index below. An IO module has one or multiple slots.
- **Slot**: Indicates the location of the IO module in the IO device.
- **Subslot**: IO interface inside the slot. This defines data types such as bit data and byte data, and the meanings of the data types.
- **Index**: Data in a Subslot.

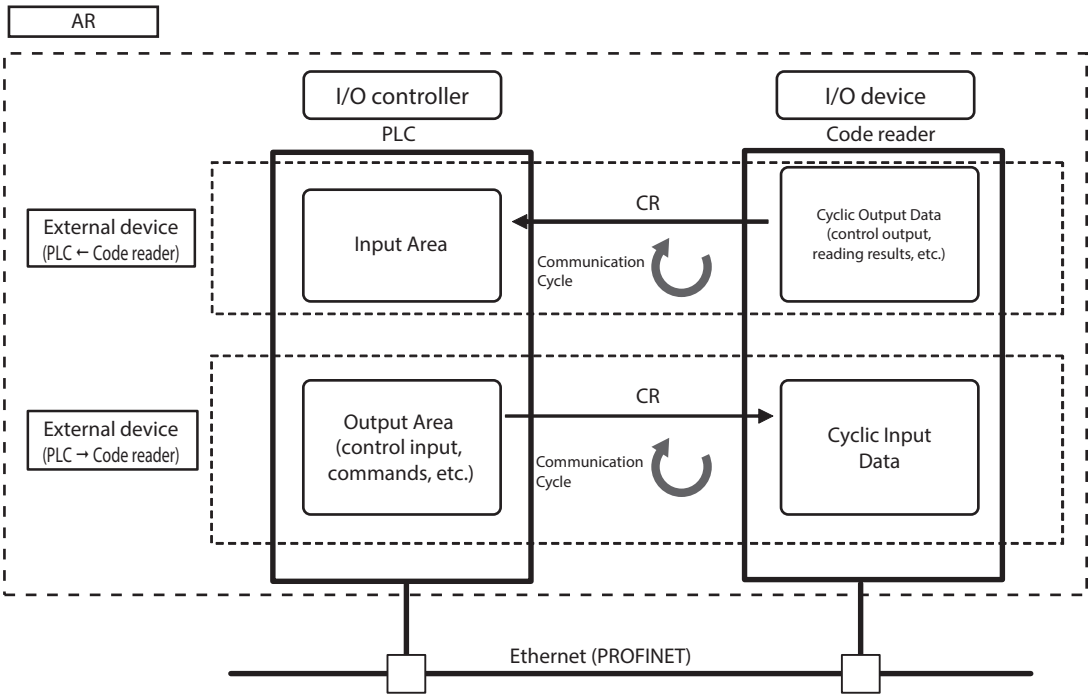
The above information is described in the GSDML file of this code reader, and the IO controller uses the GSDML file of this code reader to build the system.

Additional Information

When an IO device is used in PROFINET, the GSDML file that describes the device functions and properties is used to configure the network configuration settings.
When this code reader is used in PROFINET as an IO device, the GSDML file of this code reader must be installed in the engineering tool.

Data Communication in PROFINET IO

For an IO controller and IO device to communicate, a connection called an AR (Application Relation) must first be established between the two devices. When the AR connection is established, data communication between the IO controller and IO device takes place by means of a CR (Communication Relation) that defines the content of the data communication. An IO device can establish AR relations with multiple communication devices. In addition, multiple CR relations can be defined inside one AR. By establishing multiple CR relations inside one AR, communication that requires multiple profiles or differing Subslots can be performed. It is also possible to set a cycle time for each CR or IO.



CR is classified into IO data CR, record data CR, and alarm CR. Within the IO data CR, data communication is performed for each refreshing task period. Within CRs other than the IO data CR, communication takes place between the periodic data communications. Within the record data CR, the I/O

controller will send commands to the IO device(s) at any time. IO device(s) will send back responses to the IO controller.

Communication Specifications of PROFINET IO

The communication specifications of PROFINET IO are described below.

Communication Specifications	Type	Details	Support
Periodic data communication method	RT (real-time) communication	Uses standard Ethernet hardware and achieves the same level of performance as the existing Fieldbus.	Supported
	IRT (Isochronous real-time) communication	This method provides a higher level of assurance than RT that communication will be executed within a specific time. Intended for use in systems such as motion control that require strict real-time.	Not supported

PROFINET IO specifies the supported functions by conformance class, with consideration given to the application.

Class	Overview	Support
Class A	Supports the basic functions of RT communication.	Supported
Class B	This class adds network diagnosis and redundancy functions used in process automation and other applications.	Not Supported
Class C	Supports IRT communication that realizes reliable synchronization.	Not Supported

The functions below are defined in Class A.

Function	Overview
Cyclic Data Exchange	Real-time data communication between the IO controller and IO devices at determined cycles. Set by IO data CR.
Acyclic Parameter Data / Device Identification	Used for parameter settings, IO device configuration, and reading of device information. Set by record data CR.
Device / Network Diagnosis	Communication for the purpose of sending alarms and statuses from IO devices to the IO controller. Set by Alarm CR.

The functions below are defined in Class B, which expands upon Class A.

Function	Overview
SNMP (Simple Network Management Protocol)	Allows additional Network Diagnostics via Management Information Base 2 (MIB2) and Lower Link Layer Discovery Protocol-MIB(LLDP-EXT-MIB).
PDEV (Physical Device Object)	Can also gather diagnostic information using acyclic PROFINET services.

4-2 Code Reader Communications for PROFINET Connections

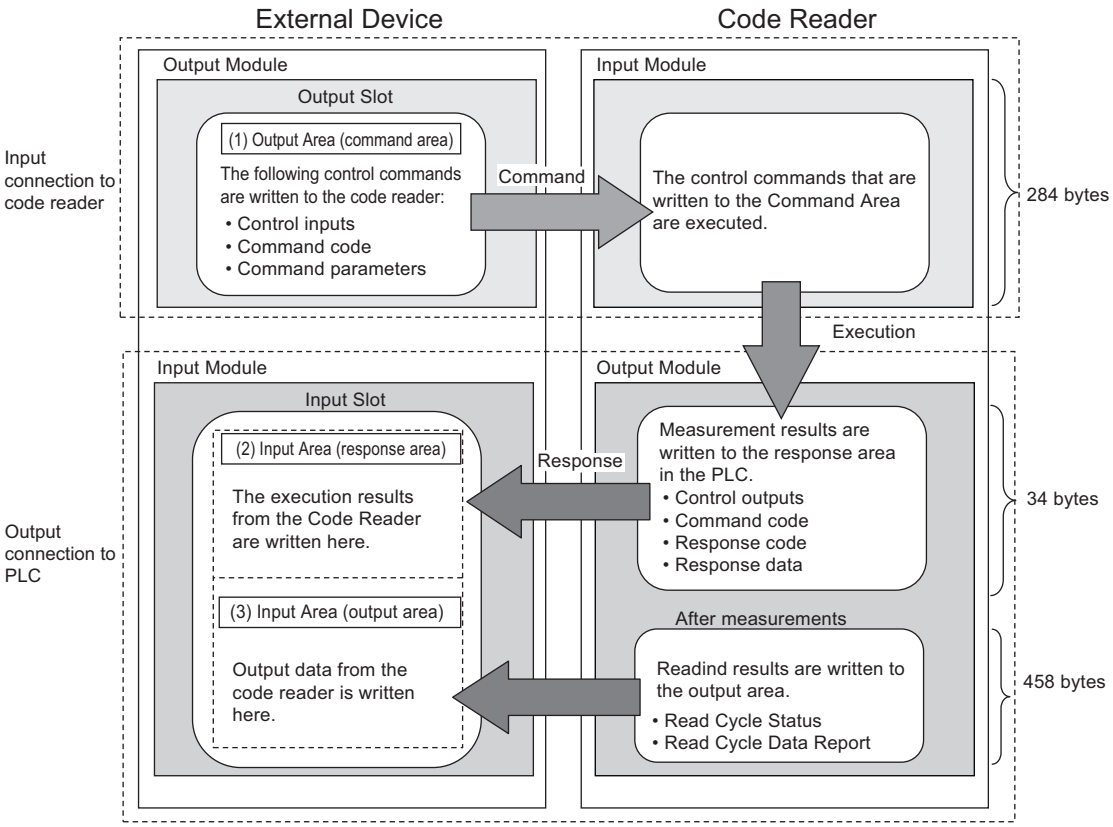
You can use PROFINET IO data CR to communicate between the PLC and the code reader to perform control via command/response communications or to output data after measurements.
This code reader complies with PROFINET conformance class A.
To connect to external devices and communicate using PROFINET, configure the PROFINET IO data CR settings with the engineering tool.
For details on the IO data CR settings in the engineering tool, refer to the manual for each engineering tool.

4-2-1 Types of Communications Areas

For PROFINET communications, the following three communications areas are used in the PLC to perform communications.

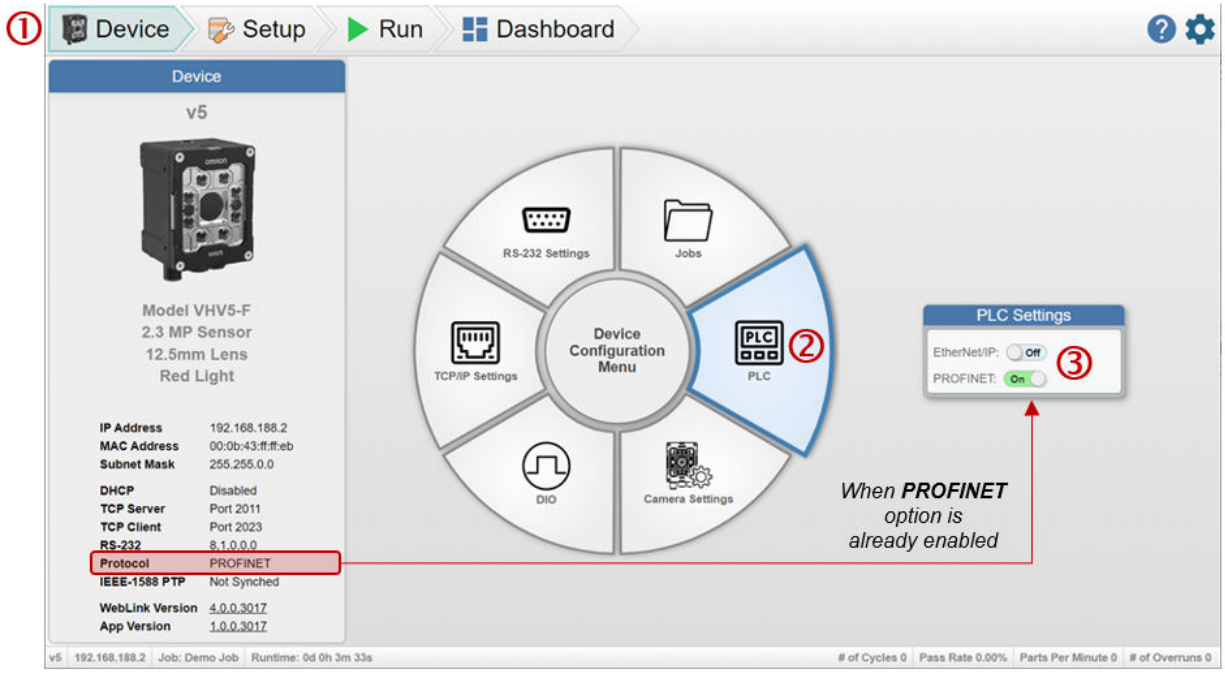
Command / Response Communications	(1) Output Area (Command Area)	This is the area to which you write control commands for this reader to execute.
	(2) Input Area (Response Area)	This is the area to which this reader writes the results of control commands executed from the command area.
Data Output after Reading	(3) Input Area (Output Area)	This is the area to which this code reader writes output data for reading after a read cycle is performed.

All examples in this manual assume that the Input Area (Response Area) (2) and Input Area (Output Area) (3) are assigned to continuous memory addresses or variables.


External Device
Code Reader
Output Module
Output Slot
(1) Output Area (command area)
The following control commands are written to the code reader:
• Control inputs
• Command code
• Command parameters
Command
Input Module
The control commands that are written to the Command Area are executed.
284 bytes
Input connection to code reader
Execution
Input Module
Input Slot
(2) Input Area (response area)
The execution results from the Code Reader are written here.
(3) Input Area (output area)
Output data from the code reader is written here.
Response
Output Module
Measurement results are written to the response area in the PLC.
• Control outputs
• Command code
• Response code
• Response data
34 bytes
After measurements
Readind results are written to the output area.
• Read Cycle Status
• Read Cycle Data Report
458 bytes
Output connection to PLC

4-3 Setting Up PROFINET Communications

4-3-1 Enabling PLC Communications (PROFINET)



The **Device** view shows the current status and settings of the reader in the left-hand pane. The Rotary Device Configuration Menu in the middle is used to set up communication, industrial protocols, and other unique camera settings. When menu items are selected, settings dialogs appear to the right of the menu wheel. If a parameter is changed, the user will be prompted to Apply the settings.

1. Select the **Device** view in WebLink.
2. Select **PLC** option on Rotary Device Configuration Menu.
3. Enable **PROFINET** option on PLC settings dialog (if not enabled yet).
4. Click on **Apply Changes** button to confirm the selection (only available if **PROFINET** option has just been enabled).

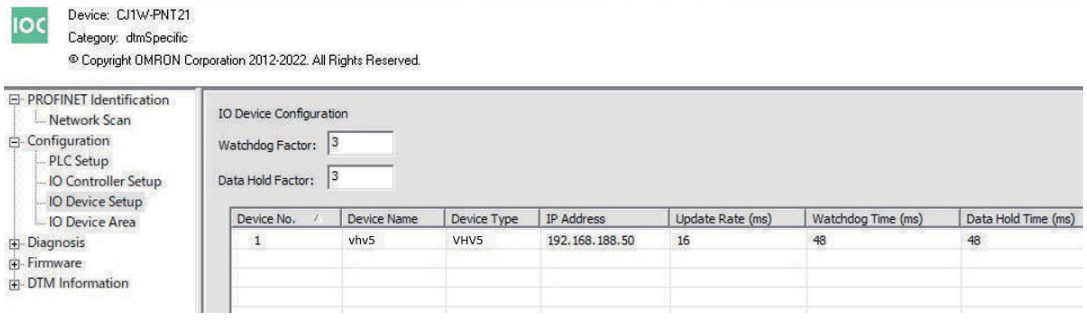
Please refer to "Enabling PLC Communications" in the *Autofocus Multicode Reader VHV5-F Series User Manual (Z476-E (84-9000xxx-xx))*.

Communications Settings Procedure

To use PROFINET communication, the settings below must be configured.

Configure Network Settings of code reader	Set in Omron Device Discovery Utility (DDU).
↓	
Configure Default PROFINET Settings	Set in WebLink.
↓	
Configure IO Supervisor (Computer) Settings • IP Address Settings	
↓	
Configure IO Controller Settings • IP Address Settings • PROFINET IO System Settings • IO Device Settings and Assignments*1 • Compile and Save Settings	Configure the settings with the engineering tool. When using the code reader with PROFINET, install a GSDML file that defines the VHV5-F IO data CR connection information in the engineering tool. The GSDML file can be downloaded from our website. For PROFINET IO system settings, refer to applicable engineering tool manual(s).
↓	
Transfer Settings and Check Connection • Check IO Controller Connection • Transfer Parameters • Check Connection Status • Check Data Assignments	Connect the computer (engineering tool), code reader, and external devices, and use the engineering tool to transfer settings and check communication.

*1. If VHV5-F IP address is assigned in the PLC project and the PLC is not connected to the network when the VHV5-F is powered, it will revert to the default IP address "192.168.188.2", until the PLC is reconnected to the network.
The picture below shows the PROFINET configuration page for the Omron PLC, but this equally applies to other PLC vendors.



IO Modules and Memory Assignments

The VHV5-F has 1 Input and 1 Output module available for PROFINET communication. Please reference *A-3 PROFINET - VHV5-F Input and Output Modules* on page A-13 for more information.

The layout for the Input and Output modules are the same as shown in *A-2-2 Memory Allocation* on page A-3 of the EtherNet/IP Specifications.

When configuring the Controller, the Input Module must be assigned to Slot 1 and Output Module must be assigned to Slot 2 of the VHV5-F code reader. The example below shows how the VHV5-F code reader is mapped to Controller memory. Notice that in this example the Input and Output Module use contiguous memory to allow the memory to be mapped to the corresponding PLC Data Type.

Example: VHV5-F PROFINET Input Module Assignment and Memory Mapping

Module	Rack	Slot	Sub-Slot	I address	Q address	Mapping to PLC Data Type	Data Type
VHV5 Input	0	1				s_VHV5_In_100	
Acquire Status Bits	0	1	1	0..1		Acquire Status	Struct
Cycle ID	0	1	2	2..9		CycleID	ULInt
Report ID Ready	0	1	3	10..17		ReportIDReady	ULInt
Current Read Mode Register	0	1	4	18..19		ReaderMode	Word
Fault Code	0	1	5	20..21		ResponseCode	Word
Job Slot ID	0	1	6	22..23		JobSlotID	Uint
Job Status	0	1	7	24..25		JobStatus	Struct
Focus Distance	0	1	8	26..27		FocusDistance	Int
Command Status	0	1	9	28..29		CommandStatus	Struct
Physic Input Status	0	1	10	30..31		DigitalInputStatus	Struct
Physic Output Status	0	1	11	32..33		DigitalOutputStatus	Struct
Cycle Status	0	1	12	34..35		CycleStatus	Struct
Read Cycle End Time	0	1	13	36..43		ReadCycleEndTime	ULInt
Number of Codes	0	1	14	44..47		NumberOfCodes	Dint
Report Length	0	1	15	48..51		TotalReportLength	Dint
Report Data	0	1	16	52..491		ReportData	Array[0..439] of Byte

Example: VHV5-F PROFINET Output Module Assignment and Memory Mapping

Module	Rack	Slot	Sub-Slot	I address	Q address	Mapping to PLC Data Type	Data Type
VHV5 Output	0	2				s_VHV5_Out_197	
Read Cycle Control Bits	0	2	1		0..1	ReadCycleControl	Struct
Read ID Ack	0	2	2		2..9	ReportIDAck	ULInt
Reader Mode Bits	0	2	3		10..11	ReaderMode	Word
Reader Control Bits	0	2	4		12..13	ReaderControl	Struct
Job Slot ID	0	2	5		14..15	JobSlotID	Uint
Job Control Bits	0	2	6		16..17	JobControl	Struct
Command Control Bits	0	2	7		18..19	CommandControls	Struct
Focus Distance	0	2	8		20..21	FocusDistance	Int

Module		Rack	Slot	Sub-Slot	I address	Q address	Mapping to PLC Data Type	Data Type
	System Command Length	0	2	9		22..15	CmdLength	Dint
	System Command	0	2	10		26..281	CmdData	Array[0..255] of Byte
	Physical Output Register	0	2	11		282..283	DIO_Control	Struct

For information on the PLC data types and variables used to communicate via PROFINET with the VHV5-F Code Reader, see *A-4 Accessing Controller (PLC/MAC) Communication Areas using Variables* on page A-15.

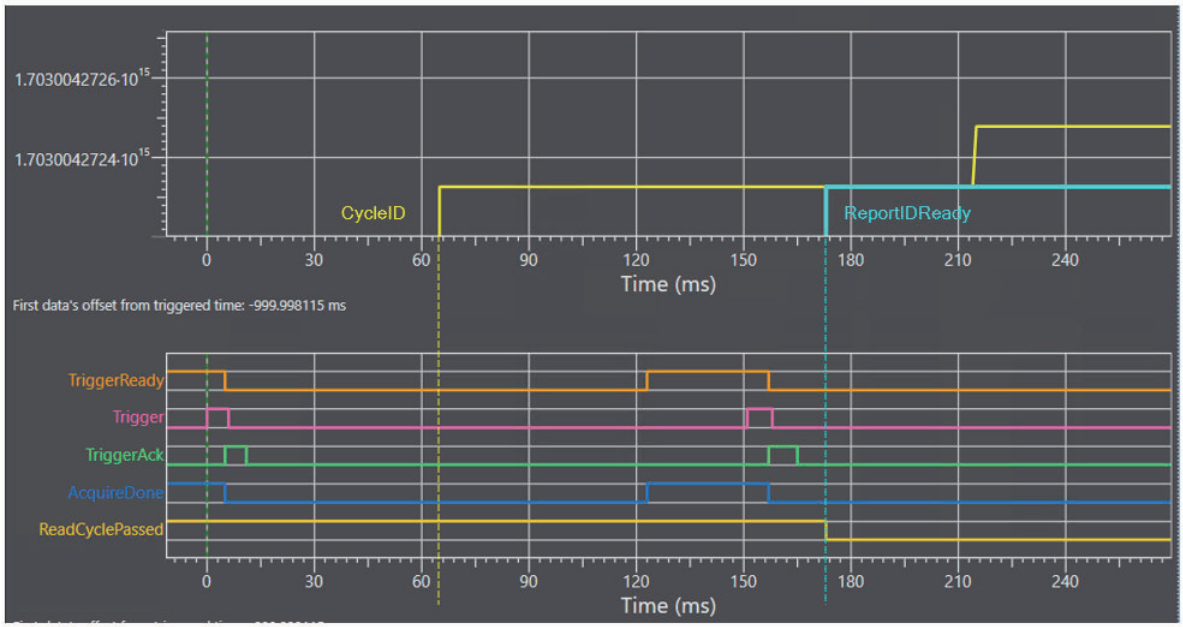
4-4 Communication Flow Between PLC and Code Reader

1. If needed, change reader mode to run mode. The PLC changes the Output Assembly memory area - Reader Mode to 1 and changes the Set Reader Mode to TRUE. The PLC Input Assembly memory area – Reader Mode changes to 1.
2. The PLC confirms that Trigger Ready is TRUE indicating that the reader is ready to be triggered.
3. When the Trigger bit is changed from FALSE to TRUE, the code reader executes a Read Cycle.
4. After the image capture, Cycle ID changes indicating that the decoding has started.
5. Report ID Ready changes to match the Cycle ID to indicate that the Read Cycle is complete.
6. The decoded data is reported into the Input Assembly memory area.

4-5 Timing Chart

4-5-1 Timing Chart Description

VHV5-F Input (100)



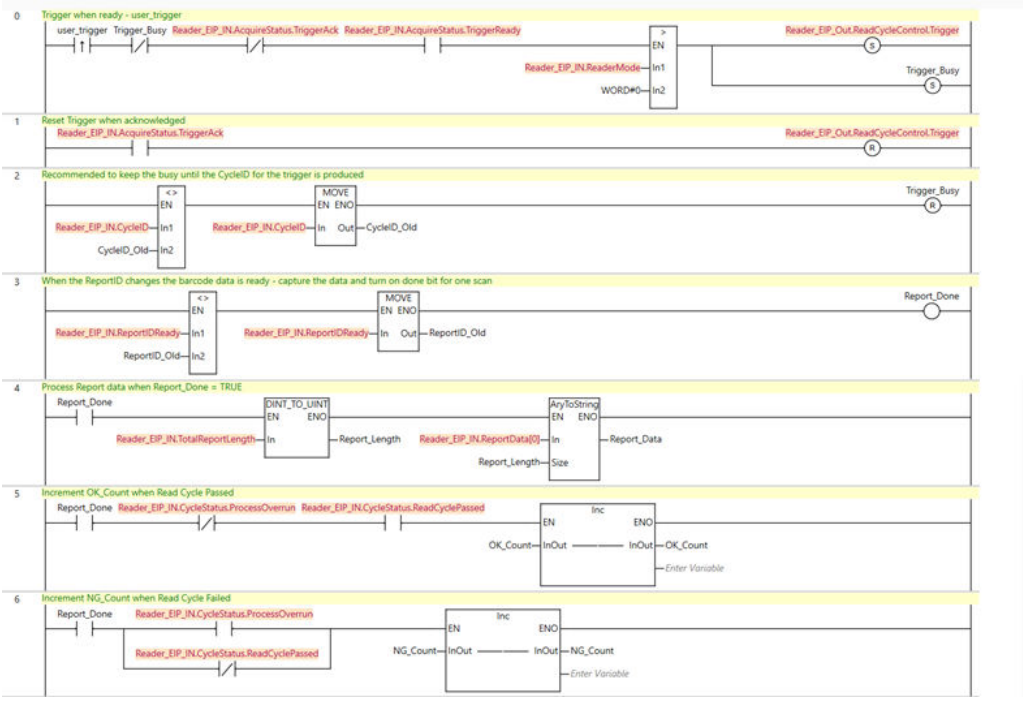
1. Rising edge of **Trigger** starts first read cycle. (0 ms)
2. **Trigger Acknowledged** turns ON when Trigger ON is detected and turns OFF when Trigger OFF is detected. (5 ms)
3. **Acquisition Done** and **Trigger Ready** turn OFF during the image capture(s). (5 ms) If the reader is configured for multiple image captures, these signals could turn ON depending on the delay between captures and will turn OFF at the start of the subsequent capture. Two Captures are shown in the example above.
4. The **Cycle ID** value changes indicating that Decoding has started on the first image capture. (66 ms)
5. The **Acquisition Done** and **Trigger Ready** turn ON because image captures are completed. (124 ms)
6. Rising edge of **Trigger** starts second read cycle. (152 ms)
7. The **Report ID Ready** value changes to match first Cycle ID indicating that the first read cycle is complete and the read cycle report data is available. (173 ms)
8. **Read Cycle Passed** changed to OFF to indicate that this read cycle failed. (173ms)

4-6 Sample Ladder Program

A sample ladder program is shown below.

- Input the Trigger Signal to execute Triggered Read.
- The reader provides a new CycleID at the start of the read cycle.
- The reader provides changes the ReportIDReady to match the CycleID to indicate that the read cycle is complete and results are available.
- Process the Read Cycle Report from the reader.
- On a passed read cycle increment the OK Count, on a failed read cycle increment the NG Count.

In this example, the VHV5-F Input (100) and Output (197) modules are used.



Detailed Review of Ladder Program

Rung	Description
0	Trigger reader – Triggers on the rising edge of user_trigger, if the following conditions are correct. • Trigger_Busy = FALSE • TriggerAck = FALSE • TriggerReady = TRUE • ReaderMode > 0 (reader is in run or setup mode)
1	Reset EIP Trigger when TriggerAck = TRUE
2	Wait for new Cycle ID to indicate start of read cycle • Copy CycleID to CycleID_Old in preparation for next trigger
3	Wait for Report ID to change indicating that a read cycle is completed and read cycle report is available • Copy ReportIDReady to ReportID_Old in preparation for next read cycle report
4	If read cycle report is available (Report_Done = TRUE), copy decoded barcode string to local variable
5	If read cycle report is available (Report_Done = TRUE) and read cycle passed, increment OK_Count
6	If read cycle report is available (Report_Done = TRUE) and read cycle failed, increment NG_Count

4-7 Communicating with the Code Reader with Command Data

See *A-5 Serial Commands* on page A-24 for more information.

5

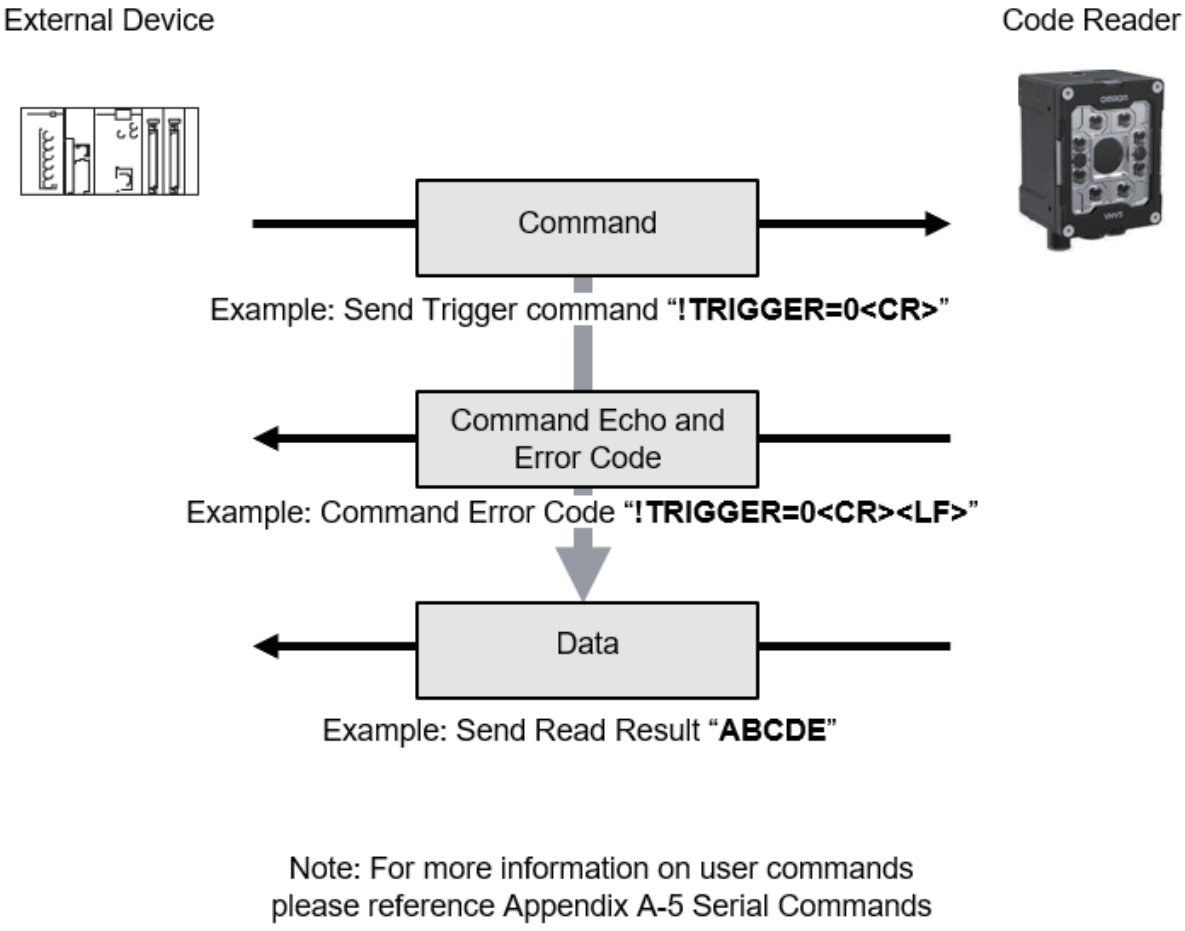
Controlling Operation and Data Output with RS-232C

5-1 Controlling Operation and Data Output with RS-232C

This section explains how to connect the code reader to an external device (such as PLC) using RS-232C communications and the methods that you can use to control the code reader and its output.

5-1-1 Communications Processing Flow

In a system configuration in which it is connected by Serial (RS-232C) communications to an external device (such as PLC), serial commands can be received and code reading results can be output to the external device.
Below is the basic flow for establishing the Serial (RS-232C) communications, executing a Read command and outputting the Read result.



Note: For more information on user commands please reference Appendix A-5 Serial Commands

5-1-2 RS-232C Wiring

There are two ways of wiring the VHV5-F for RS-232C connection.

Use the Special Cable

The following cable is an example.
Refer to *Autofocus Multicode Reader VHV5-F Series User Manual (Z476-E (84-9000xxx-xx))* for details.

● For VHV5-F

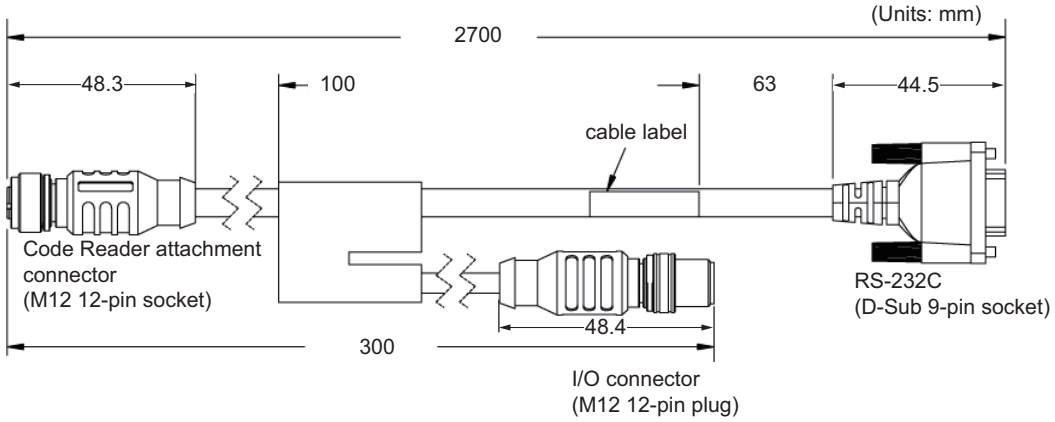
- Using the RS-232C-I/O Y cable (V430-WQR-3M).

The D-Sub 9 Pin connector can be connected directly to an IBM PC compatible Serial Port.

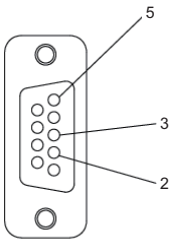
Additional Information

When connecting with OMRON CS/CJ/NJ series controller, connect OMRON Programmable Controller (CS/CJ/NJ) RS-232C cable (V430-WPLC-2M) between RS-232C-I/O Y cable (V430-WQR-3M) and CS/CJ/NJ series controller.

V430-WQR-3M



Please connect V430-W8☐ to the I/O connector (M12 plug) and connect it to power supply etc.
RS-232C (D-sub 9 Pin Female Connector)

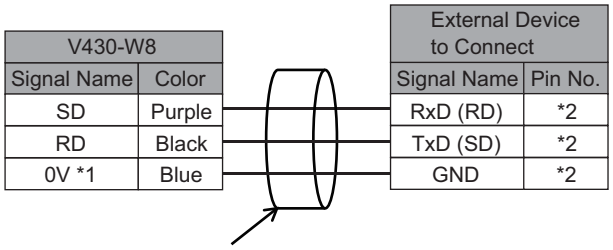
Pin No.	Signal Name	Pin Layout Diagram
1	–	
2	SD	
3	RD	
4	–	
5	0V	
6	–	
7	–	
8	–	
9	–	

Using the RS-232C Signal on I/O Cable (V430-W8☐)

RS-232C communication is possible by combining the signal for RS-232C communication (SD, RD) coming from the I/O cable (V430-W8☐) with the RS-232C signal of the device it is connected to.
(If the V430-W8☐ is connected to the M12 plug of the V430-WQR-3M, the RS-232C signal on the V430-W8☐ cannot be used.)

• I/O Cable Connection Diagram (All V430-W8)

Wire color	Pin No.	Signal Name	Function
Brown	2	24V	Power supply
Blue	7	0V	GND
Red	8	COM_IN	Common Input Signals (Input Common)
Red Striped	12	COM_OUT	Common Output Signals (Output Common)
White	1	TRIG	Read Trigger Input (Trigger)
Black	9	RD	Receive Data (RD)
Violet	10	SD	Send Data (SD)
Gray	5	OUTPUT 1	(Output 1)
Gray Striped	11	OUTPUT 2	(Output 2)
Pink	6	OUTPUT 3	(Output 3)
Green	3	INPUT 3	General Purpose Input
Yellow	4	INPUT 2	General Purpose Input
None	-	-	(Shield)



Use a shielded cable. Up to 15m cable length.

*1. 0V is shared with the 0V for the power supply of this product, so please branch it.
*2. Please connect according to your device specifications.

Example: When using OMRON Serial Communication Unit

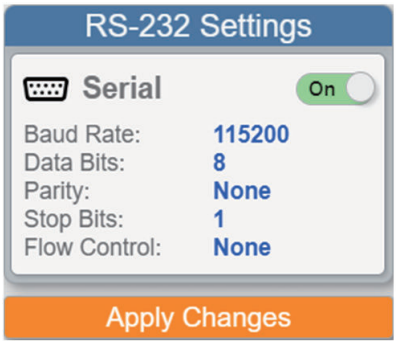
CJ1W-SCU22	
Signal Name	Pin No.
RxD (RD)	3
TxD (SD)	2
GND	9

5-1-3 Communication Settings (Serial (RS-232C))

Setting Up RS-232 Communications

● RS-232 Settings Dialog

When enabled, the RS-232 channel can be used for both command input to the reader as well as for data output.



The default reader data output is the string constructed by the Format Output step in the Read Sequence. This is same string that is displayed in the UI, as well as the string that is sent over TCP/IP, and that is sent to the PLC.

● RS-232 Settings

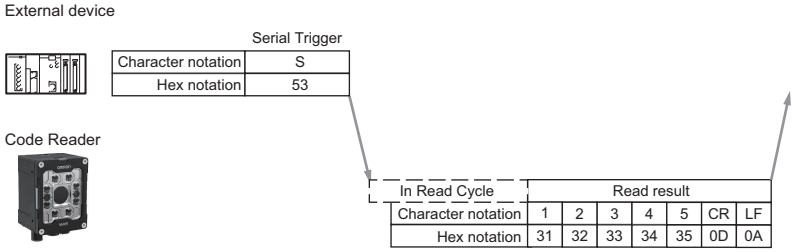
Item	Setting value [Job Default]	Description
Enabled	**[On]**, Off	The default setting of the Serial port is on. If this setting is changed, the reader must be rebooted for it to take effect.
Baud Rate	600, 1200, 2400, 4800, 9600, 19.2K, 38.4K, 57.6K, **[115.2k],** 230.4k	The rate at which the reader and host transfer data back and forth.
Data Bits	7, **[8]**	Seven or 8 bits comprising the data content
Parity	**[None]**, Even, Odd	An error detection routine in which one data bit per character is set to 1 or 0 so that the total number of bits in the data field is either even or odd.
Stop Bits	**[1]**, 2	One or two bits added to the end of each character to indicate the end of the character
Flow Control	**[None]**, Software (XOn/XOff), Hardware	Software flow control is a method of flow control used in RS-232 serial. It uses special codes, transmitted in-band, over the primary communications channel.

Behavior of the Host Protocol

Description of how each Host Protocol behaves.

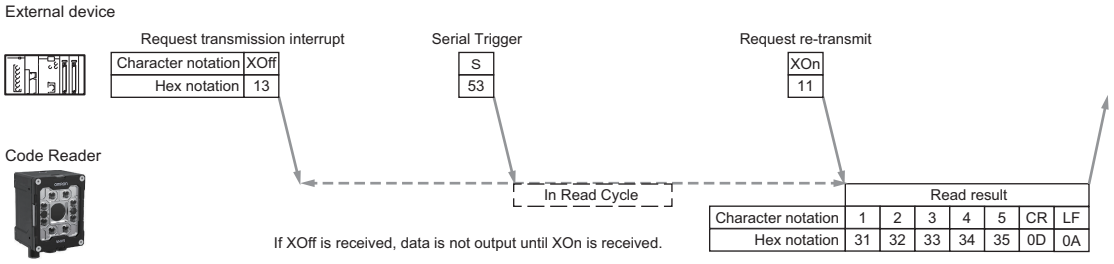
● Point-to-Point

It is a basic RS-232C communication protocol that does not control communication by a control code.



● Point-to-Point with XOn/XOff (Software Flow Control)

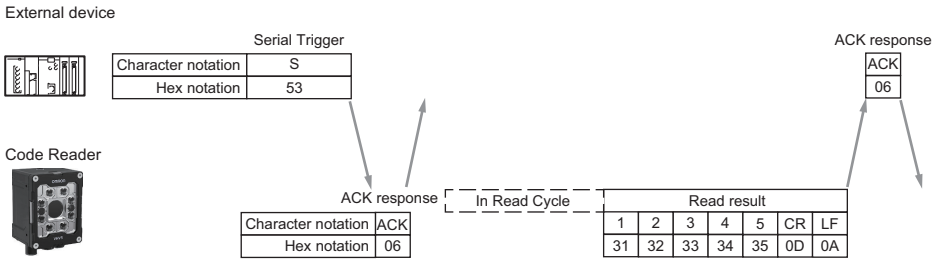
With this protocol, if the free space of the Receive buffer on the side receiving data becomes small, it sends XOff (Hex:13) to the Data Transmit side to request transmission interrupt. When it has enough free space again, it sends XOn (Hex:11) to the Data Transmit side to request Re-transmit.



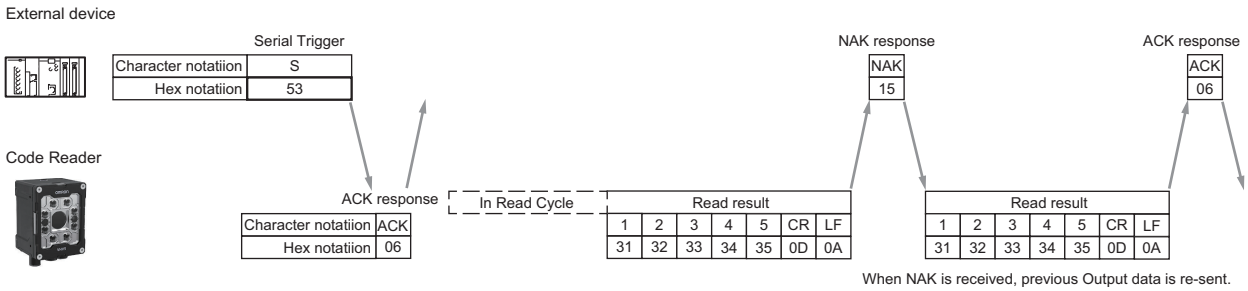
● ACK/NAK (Hardware Flow Control)

ACK/NAK Control Codes are an RS-232C communication protocol for confirming communication. When data is received, an ACK (Hex:06) response is sent to the device that sent the data. When data is not successfully received, a NAK (Hex:15) response is sent to the device that sent the data. If the device that sent the data receives a NAK response, it re-transmits its data.

- When the data was successfully received:



- When the data was not received:



Change the Command that Executes Read (Serial (RS-232C))

It is possible to change the command used in Serial (RS-232C) communications to execute Read. The method for changing the commands is the same as for Ethernet Serial (TCP) communications.

5-1-4 Setting Data to be Output after Reading a Code (Serial (RS-232C))

The code reader can be configured so that after a Read is executed, its read results are automatically output using Serial (RS-232C) communications. Additional information such as print quality grade and code position coordinates can be appended to the Read result output and the format of that output can be modified.
The methods for setting the data is the same as for Ethernet Serial (TCP) communications.

5-1-5 Additional Symbol Information that can be Appended (Serial (RS-232C))

The list of additional Symbol Information that can be appended is the same as the list for Serial (TCP) communications.

5-1-6 Controlling Operation with Serial (RS-232C) from an External Device

The code reader can be controlled and have its settings changed from an external device with the use of serial commands.
See *A-5 Serial Commands* on page A-24 for more information.

5-1-7 Serial Command List (RS-232C)

See *A-5 Serial Commands* on page A-24 for more information.

A

Appendices

This section describes the industrial communication protocols that you can use with your code reader.

A-1 Command List

A-1-1 Command List

This section lists the commands that you can use with this code reader and the communications protocols for which each command is supported.

○: Supported Command, -: Non-Supported Command

Function	Parallel	Serial*1	EtherNet/IP	PROFINET
Changes Settings	-	○	○	○
Performs Read	○	○	○	○
Performs Calibration	-	○	○	○
Gets Settings	-	-	○	○
Turns Parallel OUTPUT Signal ON/OFF	-	-	○	○
Enables / Disables Read Cycle	-	○	○	○
Saves Job Settings to Code Reader	-	-	○	○
Saves Job	-	○	○	○
Restarts Code Reader	-	-	○	○
Gets Code Quality Grade Report	-	○*2	○	○

*1. Serial communication via Serial Port (RS-232), or Ethernet Port (TCP / UDP).

*2. Information will be available if defined in the Decode Tool Output String.

A-2 EtherNet/IP Specifications

A-2-1 EDS Files by Firmware Version

Product	Code Version	EDS File	Version	Product Code	Device Major Rev	Device Minor Rev
VHV5-F	1.1.0.xxxx	VHV5.eds	1.0	3415	1	1

Function Blocks Library and Sample Program for Omron Controllers are available for download. Please visit the Omron website for Function Blocks Library and Sample Program for additional PLC / Controllers.

A-2-2 Memory Allocation

An explanation of the memory allocation of the Input Assembly (Reader → PLC) and the Output Assembly (PLC → Reader).

Input Assembly (Instance ID: 100)

The Input Assembly supports any number of multiple symbol readings, and can present the result as the Default Data Report or as the Extended Data Report which includes information of each symbol.

Input Member Structure

Member Name	Size (Bytes)
ACQUIRE STATUS	2
CYCLE ID (TRIGGER ID)	8
REPORT ID READY	8
READER MODE	2
FAULT (RESPONSE) CODES	2
JOB SLOT ID	2
JOB STATUS	2
FOCUS DISTANCE	2
COMMAND STATUS	2
DIGITAL INPUT STATUS	2
DIGITAL OUTPUT STATUS	2
CYCLE STATUS (REPORT)	2
READ CYCLE END TIME	8
NUMBER OF CODES	4
TOTAL REPORT LENGTH	4
REPORT DATA	440

Total Size: 492 Bytes

Memory Allocation				
Member Name	Data Type	Bit Number	Data Length	Byte Offset
Acquire Status	WORD		2 Byte	0

Memory Allocation				
Member Name	**Data Type**	**Bit Number**	**Data Length**	**Byte Offset**
Trigger Ready		*0*	*1 bit*	
Trigger Ack		*1*	*1 bit*	
Acquire Done		*2*	*1 bit*	
Trigger Overrun		*3*	*1 bit*	
Reserved		*4 - 15*	*12 bit*	
Cycle ID (Trigger ID)	**ULINT**		**8 Byte**	**2**
Report ID Ready	**ULINT**		**8 Byte**	**10**
Reader Mode	**WORD**		**2 Byte**	**18**
Fault (Response) Codes	**WORD**		**2 Byte**	**20**
System Fault		*0*	*1 bit*	
Subsystem ID		*1 - 4*	*4 bit*	
Subsystem Error Code		*5 -15*	*11 bit*	
Job Slot ID	**WORD**		**2 Byte**	**22**
Job Status	**WORD**		**2 Byte**	**24**
Job Loaded		*0*	*1 bit*	
Change Job Ack		*1*	*1 bit*	
Change Job Done		*2*	*1 bit*	
Save Job Ack		*3*	*1 bit*	
Save Job Done		*4*	*1 bit*	
Reserved		*5 -15*	*11 bit*	
Focus Distance	**INT**		**2 Byte**	**26**
Command Status	**WORD**		**2 Byte**	**28**
Command Ack		*0*	*1 bit*	
Command Done		*1*	*1 bit*	
Train Match String Ack		*2*	*1 bit*	
Train Match String Done		*3*	*1 bit*	
Direct Focus Set Ack		*4*	*1 bit*	
Direct Focus Set Done		*5*	*1 bit*	
Reserved		*6 -15*	*10 bit*	
Digital Input Status	**WORD**		**2 Byte**	**30**
Input 1 Status		*0*	*1 bit*	
Input 2 Status		*1*	*1 bit*	
Input 3 Status		*2*	*1 bit*	
Reserved		*3 - 15*	*13 bit*	

Member Name	Data Type	Bit Number	Data Length	Byte Offset
Digital Output Status	**WORD**		**2 Byte**	**32**
Memory Allocation (Cont.)				
Output 1 Status		*0*	*1 bit*	
Output 2 Status		*1*	*1 bit*	
Output 3 Status		*2*	*1 bit*	
Reserved		*3 - 15*	*13 bit*	
Cycle Status (Report)	**WORD**		**2 Byte**	**34**

Member Name	Data Type	Bit Number	Data Length	Byte Offset
Read Cycle Passed		*0*	*1 bit*	
All Codes Found		*1*	*1 bit*	
All Codes Read		*2*	*1 bit*	
All Codes Match		*3*	*1 bit*	
All Codes Quality		*4*	*1 bit*	
Process Overrun		*5*	*1 bit*	
Reserved		*6 - 15*	*10 bit*	
Read Cycle End Time	**ULINT**		**8 Byte**	**36**
Number Of Codes	**DINT**		**4 Byte**	**44**
Total Report Length	**DINT**		**4 Byte**	**48**
Report Data (Extended Report = **FALSE)**	**BYTE[440]**		**440 Byte**	**52**
Report Data (Extended Report = **TRUE)**	**BYTE[440]**		**440 Byte**	**52**
Record Length	*INT*		*2 Byte*	***52***
Code Status	*INT*		*2 Byte*	***54***
Code Type	*BYTE[2]*		*2 Byte*	***56***
Verification Grade (x10 Multiplier)	*INT*		*2 Byte*	***58***
Center X	*REAL*		*4 Byte*	***60***
Center Y	*REAL*		*4 Byte*	***64***
Angle	*REAL*		*4 Byte*	***68***
Data Length	*INT*		*2 Byte*	***72***
Data String	*BYTE[418]*[*1]		*418 Byte*[*1]	***74***

*1. With Extended Report = TRUE, Data String length could be 1 to 418 bytes. The actual length is determined by the length of the decode.

ASSEMBLY SIZE: 492 BYTES

Member Description

Acquire Status

Shows statuses related to Acquire operation.

Bit	Signal Name	Description
0	Trigger Ready	ON = Reader is ready to accept a new trigger
1	Trigger Ack	ON = Reader EtherNet/IP Output Assembly Trigger bit is ON
2	Acquire Done	ON = Reader has completed the Acquire (Capture) operation
3	Trigger Overrun	ON = Reader has received a trigger while Trigger Ready was OFF
4-15	Reserved	Reserved for future use

Note: If the reader is configured for multiple image captures, **Trigger Ready** and **Acquire Done** signals could turn ON depending on the delay between captures and will turn OFF at the start of the subsequent capture.

Cycle ID (Trigger ID)

Returns the timestamp (in microseconds) of when the first Decode Tool started running.

Report ID Ready

Returns the value of the **Cycle ID** when the results related to the read cycle pointed by **Cycle ID** are available in the **Report Data**.

If the **Require Report Ack** (Assembly Output) is ON, the PLC must set the **Report ID Ack** (Assembly Output) to the current **Report ID Ready** value to acknowledge that **Report Data** has been read.

Reader Mode

Returns the current mode of the reader:

Value	Reader Mode
0	Offline
1	Run Mode
2	Setup Mode

Fault (Response) Codes

Indicates that the reader has provided a response to a command / task. This information is reset by **Reset System Fault** (Assembly Output).

Bit	Signal Name	Description
0	System Fault	ON = Error or Fault (check Subsystem ID and Subsystem Error Code)
1-4	Subsystem ID*	Indicates which Subsystem is reporting a response
5-15	Subsystem Error Code**	Indicates the Error Code of the Subsystem if any

Subsystem Error Code											Subsystem ID				Fault
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	**0**
MSB															**LSB**

Subsystem ID Information			
Subsystem ID (Bit 1-4)*			Description
Bin	Dec	Hex	
0001	1	1	Job Change
0010	2	2	Inspection
0011	3	3	System Command
0100	4	4	Focus
0101	5	5	Photometry
0110	6	6	Train Match
0111	7	7	Learn
1000	8	8	Optimize
1001	9	9	Job Save
1010	10	A	Mode Change

Subsystem Error Code											Subsystem ID				Fault
15	14	13	12	11	10	9	8	7	6	5	**4**	**3**	**2**	**1**	0
MSB															**LSB**

Subsystem Error Code Information				
Subsystem Error Code (Bit 5-15)**				Description
Subsystem ID	Bin	Dec	Hex	
Job Change (1)	**…0000**	0	0	Successful Job change
	…0001	1	1	Unexpected error
	…0010	2	2	Invalid Slot number specified
	…0011	3	3	Not allowed because you were in setup mode
Inspection (2)	**…0000**	0	0	NA
	…0001	1	1	Last report has not been acknowledged yet
System Command (3)	**…0000**	0	0	Command executed successfully
	…xxxx	>1	>1	Error code specific to the command See *A-5 Serial Commands* on page A-24 for more information.
Focus (4)	**…0000**	0	0	Focus set successfully
	…0001	1	1	No job is loaded
	…0010	2	2	Invalid Capture Index specified
	…0011	3	3	Focus value out of range
Photometry (5)				NA
Train Match (6)	**…0000**	0	0	Match String Trained successfully
	…0001	1	1	No symbology tool in job to train on
Learn (7)				NA
Optimize (8)				NA
Job Save (9)	**…0000**	0	0	Successful Job Save
	…0100	4	4	Error on save
	…1000	8	8	Job is invalid and could not be saved
	…1011	11	B	Specified slot does not have a job to save
	…1100	12	C	Slot index is not valid
Mode Change (10)	**…0000**	0	0	Successful Mode Change
	…0001	1	1	Unexpected error changing modes
	…0010	2	2	Invalid Reader Mode Specified

Subsystem Error Code											Subsystem ID				Fault
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	4	3	2	1	0
MSB															**LSB**

Job Slot ID

Indicates which Job/Slot is currently loaded in the reader.

Job Status

Shows statuses related to Job operations.

Bit	Signal Name	Description
0	Job Loaded	ON = Reader has an active Job loaded
1	Change Job Ack	ON = Reader has received the Change Job request
2	Change Job Done	ON = Reader has completed the Change Job operation
3	Save Job Ack	ON = Reader has received the Save Job request
4	Save Job Done	ON = Reader has completed the Save Job operation
5-15	Reserved	Reserved for future use

Focus Distance

Returns the current Focus Distance of the reader.

Command Status

Shows statuses related to Command operations.

Bit	Signal Name	Description
0	Command Ack	ON = Reader has received a Command request
1	Command Done	ON = Reader has completed the Command operation
2	Train Match String Ack	ON = Reader has received the Train Match String request
3	Train Match String Done	ON = Reader has completed the Train Match String operation
4	Direct Focus Set Ack	ON = Reader has received the Direct Set Focus request
5	Direct Focus Set Done	ON = Reader has completed the Direct Set Focus operation
6-15	Reserved	Reserved for future use

Digital Input Status

Shows current logic state of the 3 Digital Inputs of the reader.

Bit	Signal Name	Description
0	Input 1 Status	ON = Input 1 is ACTIVE
1	Input 2 Status	ON = Input 2 is ACTIVE
2	Input 3 Status	ON = Input 3 is ACTIVE
3-15	Reserved	Reserved for future use

Digital Output Status

Shows current logic state of the 3 Digital Outputs of the reader.

Bit	Signal Name	Description
0	Output 1 Status	ON = Output 1 is ACTIVE
1	Output 2 Status	ON = Output 2 is ACTIVE
2	Output 3 Status	ON = Output 3 is ACTIVE
3-15	Reserved	Reserved for future use

Cycle Status (Report)

Shows statuses related to Read Cycle.

Bit	Signal Name	Description
0	Read Cycle Passed	ON = All codes have been found, qualified, matched and passed verification (if enabled)
1	All Codes Found	ON = All codes have been found

Bit	Signal Name	Description
2	All Codes Read	ON = All codes have been found and did satisfy code type and did have qualifying content or code read (if Read Qualifiers are disabled).
3	All Codes Match	ON = All codes matched expected string values (if enabled) or code read (if Match String is disabled).
4	All Codes Quality	ON = All codes passed code quality verification (if enabled) or code read (if Grading is disabled).
5	Process Overrun	ON = All processing resources are currently in use and could not process this result. It will be set or reset for each Read Cycle. A process overrun will be posted immediately, causing the Report ID Ready sequence to be in a different order than the Cycle ID sequence until all read cycles in process before the process overrun have completed.
6-15	Reserved	Reserved for future use

Read Cycle End Time

Returns the timestamp (in microseconds) of when the Read Cycle was completed.

Number Of Codes (Extended Report = FALSE)

Returns -1 to indicate that the Extended Report is disabled.

Number Of Codes (Extended Report = TRUE)

Returns the number of codes decoded in the Job.

Total Report Length

Returns the number of bytes to get to the end of the Report Data.

Report Data (Extended Report = FALSE)

Returns the Default Data Report.

Report Data (Extended Report = TRUE)

Returns the Extended Data Report. Each Record in the Extended Data Report contains the following values for each code:

Extended Report	Description
Record Length	Returns the number of bytes to get to the end of the current Report
Code Status	Returns the Code Status using the same bit assignments as defined in the Cycle Report
Code Type	Returns the Code Type based on AIM Symbology Identifier, without the leading ']' character. For example: • *Data Matrix will be reported as **"d1"** (instead of "**]d1**")* • *QR Code will be reported as **"Q1"** (instead of "**]Q1**")*
Verification Grade	Returns the Verification Grade multiplied by 10 (if enabled): 0.0 (00) ~ 4.0 (40)
Center X	Returns the Center X location of the Code (pixels)
Center Y	Returns the Center Y location of the Code (pixels)
Angle	Returns the Rotation of the Code (degrees)
Data Length	Returns the Length of the data in **Data String**
Data String	Returns the Decode Data

Output Assembly (Instance ID: 197)

The Output Assembly can send several commands to the reader.

Output Member Structure

Member Name	Size (Bytes)
READ CYCLE CONTROL	**2**
REPORT ID ACK	**8**
READER MODE	**2**
READER CONTROL	**2**
JOB SLOT ID	**2**
JOB CONTROL	**2**
COMMAND CONTROL	**2**
FOCUS DISTANCE	**2**
COMMAND LENGTH	**4**
COMMAND STRING	**256**
DIGITAL OUTPUT CONTROL	**2**

Total Size: 284 Bytes

Memory Allocation				
Member Name	**Data Type**	**Bit Number**	**Data Length**	**Byte Offset**
Read Cycle Control	**WORD**		**2 Byte**	**0**
Use Extended Data Report		*0*	*1 bit*	
Trigger		*1*	*1 bit*	
Require Report Ack		*2*	*1 bit*	
Reserved		*2 - 15*	*14 bit*	
Report ID Ack	**LINT**		**8 Byte**	**2**
Reader Mode	**WORD**		**2 Byte**	**10**
Reader Control	**WORD**		**2 Byte**	**12**
Set Reader Mode		*0*	*1 bit*	
Reboot Device		*1*	*1 bit*	
Reset System Fault		*2*	*1 bit*	
Reserved		*3 -15*	*13 bit*	
Job Slot ID	**WORD**		**2 Byte**	**14**
Job Control	**WORD**		**2 Byte**	**16**
Change Job		*0*	*1 bit*	
Save Job		*1*	*1 bit*	
Reserved		*2 - 15*	*14 bit*	
Command Control	**WORD**		**2 Byte**	**18**
Command Exe		*0*	*1 bit*	
Train Match String		*1*	*1 bit*	
Set Focus Distance		*2*	*1 bit*	
Reserved		*3 - 15*	*13 bit*	
Focus Distance	**INT**		**2 Byte**	**20**
Command Length	**DINT**		**4 Byte**	**22**
Command String	**BYTE[256]**		**256 Byte**	**26**

Memory Allocation				
Member Name	**Data Type**	**Bit Number**	**Data Length**	**Byte Offset**
Digital Output Control	**WORD**		**2 Byte**	**282**
Output 1 Enabled		*0*	*1 bit*	
Output 2 Enabled		*1*	*1 bit*	
Output 3 Enabled		*2*	*1 bit*	
Reserved		*3 - 15*	*13 bit*	

ASSEMBLY SIZE: 284 BYTES

Member Description

Read Cycle Control

Contains the commands related to the Read Cycle.

Bit	Signal Name	Description
0	Use Extended Data Report	ON = Enables the Extended Data Report format
1	Trigger	OFF to ON = Starts a new Read Cycle
2	Require Report Ack	ON = Requires the PLC to acknowledge the current report before receiving the next one, by copying **Report IDReady** (Input Assembly) and assigning this value to **Report ID Ack.**
3-15	Reserved	Reserved for future use

Report ID Ack

Must have the current value of **Report ID Ready**(Input Assembly) to acknowledge that **Report Data** has been read. Applicable only if **Require Report Ack = 1**.

Reader Mode

Defines the mode of the Reader when **Set Reader Mode = OFF to ON**.

Value	Reader Mode
0	Offline
1	Run Mode
2	Setup Mode

• Reader Control

Contains the commands related to reader control.

Bit	Signal Name	Description
0	Set Reader Mode	OFF to ON = Changes to the mode indicated by **Reader Mode**
1	Reboot Device	ON = Reboots the Reader Note – This bit should be set ON until the reboot starts (a couple of seconds) and then changed to OFF.
2	Reset System Fault	ON = Clears the **Fault (Response) Code** (Input Assembly)
3-15	Reserved	Reserved for future use

Job Slot ID

Defines the Slot location on the Reader for **Change Job** or **Save Job** operations.

Job Control

Contains the commands related to Job Control.

Bit	Signal Name	Description
0	Change Job	OFF to ON = Changes to the Job in the Slot indicated by **Job Slot ID**
1	Save Job	OFF to ON = Saves current Job to the Slot indicated by **Job Slot ID**
2-15	Reserved	Reserved for future use

Command Control

Contains the commands related to command control.

Bit	Signal Name	Description
0	Command Exe	OFF to ON = Executes the Command defined by **Command Length** and **Command String**, if both are correctly defined
1	Train Match String	OFF to ON = Starts the **Train Match String** operation The new match string must be entered into the Command String and the length reported via Command Length. This match string will replace the stored match strings all Decode Tools with Match String enabled.
2	Set Focus Distance	OFF to ON = Starts the **Set Focus** operation. Focus distance
3-15	Reserved	Reserved for future use

Focus Distance

Defines the new Focus Distance when **Set Focus Distance = 0 to 1**.

Command Length

Defines the Length (Bytes) of the match string, defined by **Command String** when the performing the **Train Match String** operation**.** Defines the Length (Bytes) of the command, defined by **Command String**, when performing the Command Exe operation. The Length must include the Carriage Return character <CR> when performing the Command Exe operation.

This value must be updated at least 2 RPI before the Train Match String = OFF to ON or Command Exe = OFF to ON.

Command String

Defines the match string to be saved when using **Train Match String** or the Command to be performed when using **Command Exe**. It must include the Carriage Return character <CR> at the end of the command.

This string must be updated at least 2 RPI before the Train Match String = OFF to ON or Command Exe = OFF to ON.

Digital Output Control

Contains the commands related to the 3 Digital Outputs of the reader.

Bit	Signal Name	Description
0	Output 1 Enabled	ON = Activates the Output 1
1	Output 2 Enabled	ON = Activates the Output 2
2	Output 3 Enabled	ON = Activates the Output 3
3-15	Reserved	Reserved for future use

A-3 PROFINET - VHV5-F Input and Output Modules

This section lists the commands you can use with the VHV5-F and the PROFINET industrial protocol.

Function Blocks Library and Sample Program for Omron Controllers are available for download. Please visit the Omron website for Function Blocks Library and Sample Program for additional PLC / Controllers.

A-3-1 Module Types

There are 1 Input and 1 Output Module available for PROFINET communication with the VHV5-F reader. The layout of each module and the definitions of the data in them are listed in *A-2 EtherNet/IP Specifications* on page A-3.

Model Item ID	Name	Total Size in Bytes	PROFINET Slot Allowed	PNT21 Supported
100	Input Module	492	1	No
197	Output Module	284	2	Yes

Additional Information

The maximum Input CR size for the PNT21 is 450 bytes.

Input/Output Modules

All Input/Output modules and module descriptions are the same as in *A-2 EtherNet/IP Specifications* on page A-3.

A-3-2 PROFINET Base Information

Device Identity

The PROFINET device identity information is as follows:

- **Vendor ID**
  The Vendor ID is 0x0257.
- **Device ID**
  The Device ID is 0x3416.
- **Vendor Name**
  The Vendor Name is Omron Automation Americas.
- **Device Function**
  The Device Function is:
  - MainFamily = Ident Systems
  - ProductFamily = VHV5

GSDML File

Refer to the table below to determine the correct GSDML file for your device.

PROFINET Files by Firmware Version

Product	Firmware Version	GSDML File	Version	Device ID
VHV5-F	1.0.0.xxxx	GSDML-V2.43-OmronAutomationAmericas-VHV5-20231031.xml	V2.43	0x3416

Connection Properties: RT Cyclic Messaging

Cycle Time: 4 ms
Definition: The GSD file contains element MinDeviceInterval, which is 128. Multiply this by 31.25 µs. This is the cycle time. See the PROFINET GSDML specification for more information.

A-4 Accessing Controller (PLC/MAC) Communication Areas using Variables

This section defines the variables mapped to the EtherNet/IP Assemblies / PROFINET IO Modules.
- EtherNet/IP uses tags (variables) mapped to the EtherNet/IP assemblies on the code reader.
- PROFINET references memory which is mapped to IO Modules on the code reader.

For EtherNet/IP or PROFINET, the controller needs to map tags (variables) to Input Assembly 100 (EtherNet/IP) / Input Module (PROFINET) and Output Assembly 197 (EtherNet/IP) / Output Module (PROFINET). These examples use contiguous memory mapping of the input and output assemblies / modules.

For more detailed information about the data structure of these assemblies, please refer to *A-2 EtherNet/IP Specifications* on page A-3.

A-4-1 Access Using Network Variables

Create user-defined variables that match the structures of the communications areas of the Sensor. Use Sysmac Studio to define the variables.
For information about how to Sysmac Studio, please refer to *Sysmac Studio Version1 Operation Manual (W504)*.

1 Defining the Data Types of the Variables
Define data types for variables that match the structures of the communications areas.

1) Defining a Data Type for Control Signals
First, define a BOOL array data type to access the control signals and status signals. Here, we define the data types used for defining the Output communication area: *Read Cycle Control*, *Reader Control*, *Job Control*, *Command Control*, *Digital Output Control*.

Control Signal Data Types
Type of derivative data type: Structure

Data Name		Data Type	Byte	Bit
s_ReadCycleControl		STRUCT		
	UseExtendedDataReportFormat	BOOL	0	0
	Trigger	BOOL	0	1
	RequireReportAck	BOOL	0	2
	Reserved	ARRAY[3..15] OF BOOL	0	3

Data Name		Data Type	Byte	Bit
s_ReaderControl		STRUCT		
	SetReaderMode	BOOL	0	0
	RebootDevice	BOOL	0	1
	ResetSystemFault	BOOL	0	2
	Reserved	ARRAY[3..15] OF BOOL	0	3

Data Name	Data Type	Byte	Bit
s_JobControl	STRUCT		
ChangeJob	BOOL	0	0
SaveJob	BOOL	0	1
Reserved	ARRAY[2..15] OF BOOL	0	2

Data Name	Data Type	Byte	Bit
s_CommandControl	STRUCT		
CmdExe	BOOL	0	0
TrainMatchString	BOOL	0	1
SetFocusDistance	BOOL	0	2
Reserved	ARRAY[3..15] OF BOOL	0	3

Data Name	Data Type	Byte	Bit
s_DigitalOutputControl	STRUCT		
Output1_Enable	BOOL	0	0
Output2_Enable	BOOL	0	1
Output3_Enable	BOOL	0	2
Reserved	ARRAY[3..15] OF BOOL	0	3

2) Defining a Data Type for Status Signals

First, define a BOOL array data type to access the control signals and status signals. Here, we define the data types used for defining the Input communication area: *Acquire Status*, *Job Status*, *Command Status*, *Digital Input Status*, *Digital Output Status*.

Control Signal Data Types

Type of derivative data type: Structure

Data Name	Data Type	Byte	Bit
s_AcquireStatus	STRUCT		
TriggerReady	BOOL	0	0
TriggerAck	BOOL	0	1
AcquireDone	BOOL	0	2
TriggerOverrun	BOOL	0	3
Reserved	ARRAY[4..15] OF BOOL	0	4

Data Name	Data Type	Byte	Bit
s_JobStatus	STRUCT		
JobLoaded	BOOL	0	0
ChangeJobAck	BOOL	0	1
ChangeJobDone	BOOL	0	2
SaveJobAck	BOOL	0	3
SaveJobDone	BOOL	0	4
Reserved	ARRAY[5..15] OF BOOL	0	5

Data Name	Data Type	Byte	Bit
s_CommandStatus	STRUCT		
CommandAck	BOOL	0	0

Data Name	Data Type	Byte	Bit
CommandDone	BOOL	0	1
TrainMatchStringAck	BOOL	0	2
TrainMatchStringDone	BOOL	0	3
DirectFocusSetAck	BOOL	0	4
DirectFocusSetDone	BOOL	0	5
Reserved	ARRAY[6..15] OF BOOL	0	6

Data Name	Data Type	Byte	Bit
s_DigitalInputStatus	STRUCT		
Input1_Status	BOOL	0	0
Input2_Status	BOOL	0	1
Input3_Status	BOOL	0	2
Reserved	ARRAY[3..15] OF BOOL	0	3

Data Name	Data Type	Byte	Bit
s_DigitalOutputStatus	STRUCT		
Output1_Status	BOOL	0	0
Output2_Status	BOOL	0	1
Output3_Status	BOOL	0	2
Reserved	ARRAY[3..15] OF BOOL	0	3

Data Name	Data Type	Byte	Bit
s_CycleStatus	STRUCT		
ReadCyclePassed	BOOL	0	0
AllCodesFound	BOOL	0	1
AllCodesRead	BOOL	0	2
AllCodesMatch	BOOL	0	3
AllCodesQuality	BOOL	0	4
ProcessOverrun	BOOL	0	5
Reserved	ARRAY[6..15] OF BOOL	0	6

3) Defining Data Types for Communications Area Access

Data types are defined according to the communication area to access, with one data type for Output Area and another data type for Input Area. Here, there are two Data types defined, *s_VHV5_In_100* and *s_VHV5_Out_197*.

- Data Type to access: Output Area
  Data type name: s_VHV5_Out_197
  Type of derivative data type: Structure

Data Name	Data Type	Byte	Bit
s_VHV5_Out_197	STRUCT		
ReadCycleControl	s_ReadCycleControl	0	
ReportIDAck	ULINT	2	
ReaderMode	WORD	10	
ReaderControl	s_ReaderControl	12	
JobSlotID	UINT	14	
JobControl	s_JobControl	16	
CommandControl	s_CommandControl	18	

Data Name		Data Type	Byte	Bit
	FocusDistance	INT	20	
	CmdLength	DINT	22	
	CmdData	ARRAY[0..255] OF BYTE	26	
	DigitalOutputControl	s_DigitalOutputControl	282	

For more information on the Communications Output Area, please refer to *Output Assembly (Instance ID: 197)* on page A-10.

- Data Type to access: Input Area
  Data type name: s_VHV5_In_100
  Type of derivative data type: Structure

Data Name		Data Type	Byte	Bit
s_VHV5_In_100		STRUCT		
	AcquireStatus	s_AcquireStatus	0	
	CycleID	ULINT	2	
	ReportIDReady	ULINT	10	
	ReaderMode	WORD	18	
	ResponseCode	WORD	20	
	JobSlotID	UINT	22	
	JobStatus	s_JobStatus	24	
	FocusDistance	INT	26	
	CommandStatus	s_CommandStatus	28	
	DigitalInputStatus	s_DigitalInputStatus	30	
	DigitalOutputStatus	s_DigitalOutputStatus	32	
	CycleStatus	s_CycleStatus	34	
	ReadCycleEndTime	ULINT	36	
	NumberOfCodes	DINT	44	
	TotalReportLength	DINT	48	
	ReportData	ARRAY[0..439] OF BYTE	52	

2 Defining the Variables

Define variables for the data links for the communications area data that is used in EtherNet/IP communications.

These variables use the data types that were defined above in procedure 1.

Variable	Variable Type	Network Publish Attribute	Data Type	Application
Reader_OUT	Global variable	Output	s_VHV5_Out_197	For data links to the Output Area
Reader_IN	Global variable	Input	s_VHV5_In_100	For data links to the Input Area

3 Accessing the Communications Areas from the User Program

The defined variables are used to access the communications areas for the reader using the following:

Output Area

Signal Name	Variable Name
Trigger	Reader_OUT.ReadCycleControl.Trigger

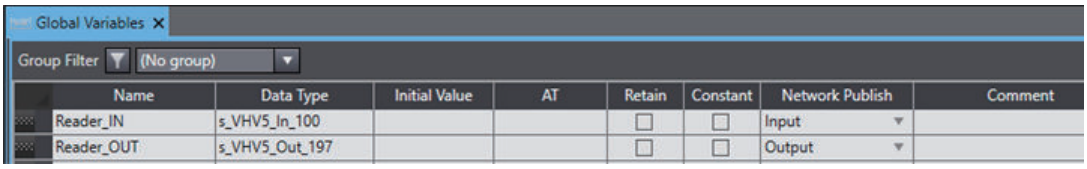
Input Area

Signal Name	Variable Name
Reader Mode	Reader_IN.ReaderMode
Trigger Ready	Reader_IN.AcquireStatus.TriggerReady
Trigger_Acknowledged	Reader_IN.AcquireStatus.TriggerAck
CycleID	Reader_IN.CycleID
Report ID Ready	Reader_IN.ReportIDReady

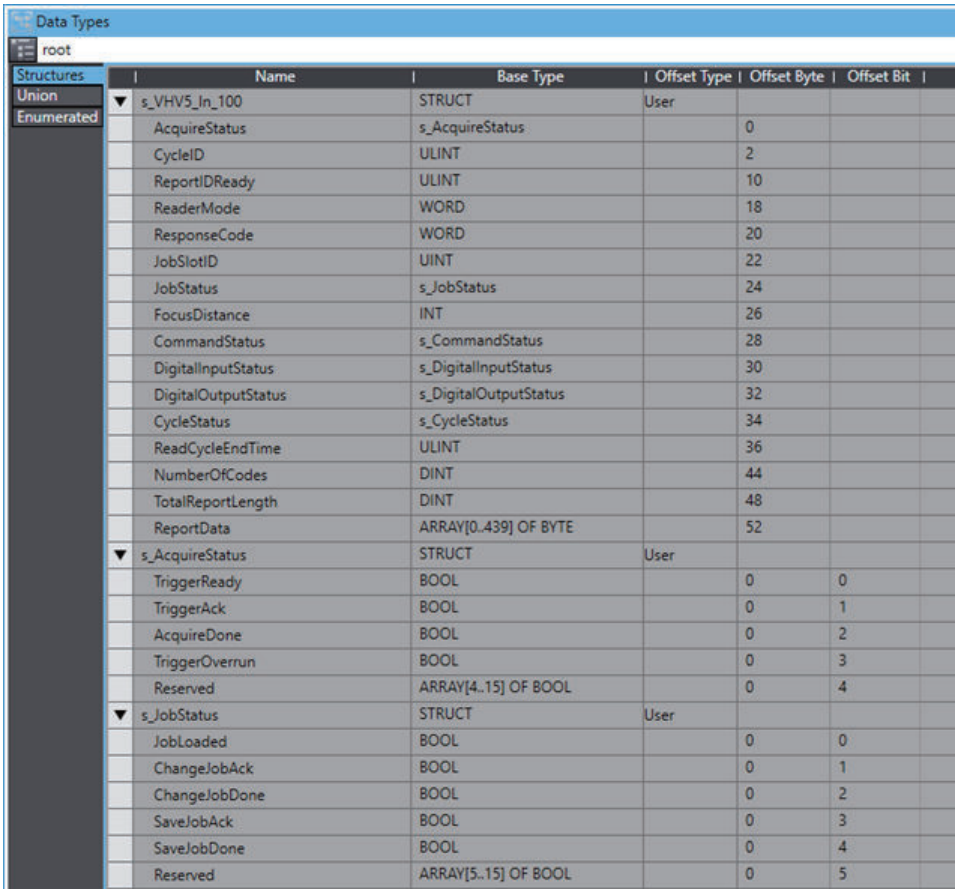
A-4-2 Triggered Read Example

Here is an example of how a triggered read cycle is executed in EtherNet/IP or PROFINET communications between a PLC and the code reader.

Example Variables



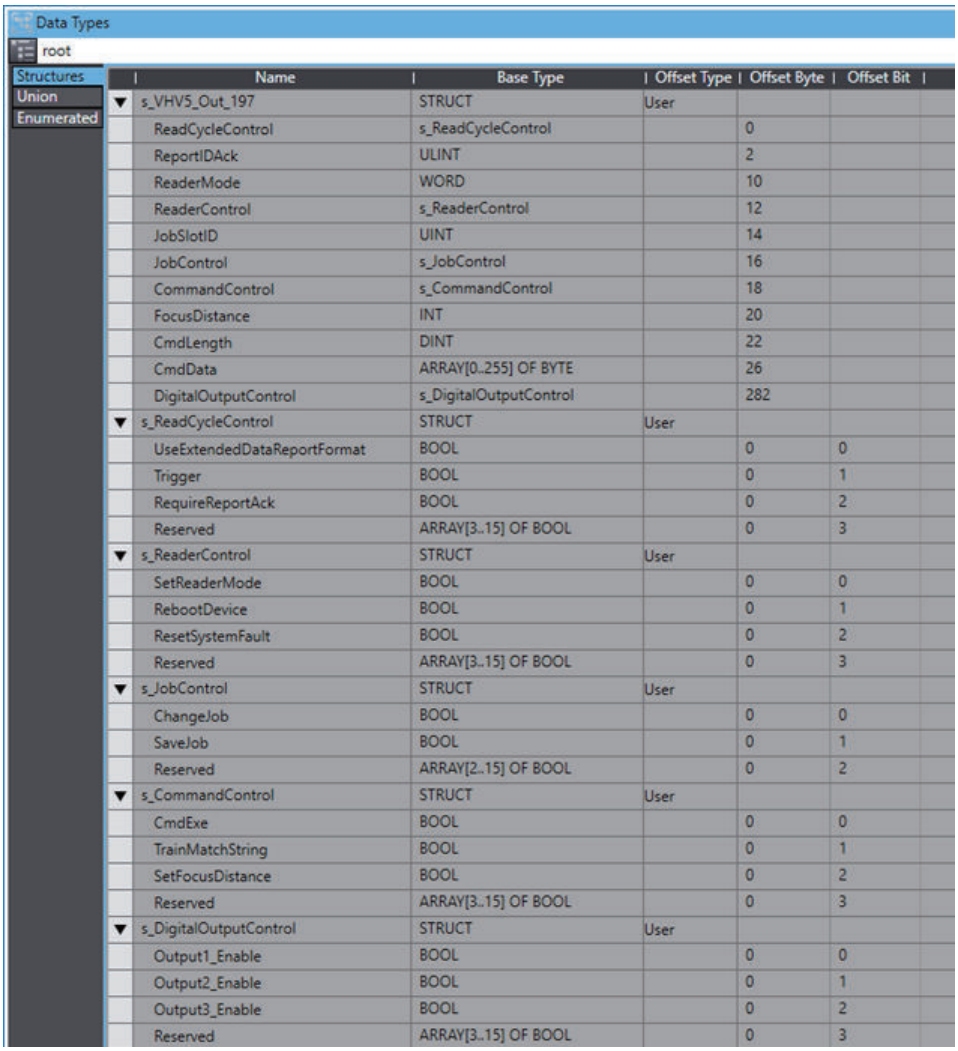
Input Assembly Structure (100)



▼	s_CommandStatus	STRUCT	User		
	CommandAck	BOOL		0	0
	CommandDone	BOOL		0	1
	TrainMatchStringAck	BOOL		0	2
	TrainMatchStringDone	BOOL		0	3
	DirectFocusSetAck	BOOL		0	4
	DirectFocusSetDone	BOOL		0	5
	Reserved	ARRAY[6..15] OF BOOL		0	6
▼	s_DigitalInputStatus	STRUCT	User		
	Input1_Status	BOOL		0	0
	Input2_Status	BOOL		0	1
	Input3_Status	BOOL		0	2
	Reserved	ARRAY[3..15] OF BOOL		0	3
▼	s_DigitalOutputStatus	STRUCT	User		
	Output1_Status	BOOL		0	0
	Output2_Status	BOOL		0	1
	Output3_Status	BOOL		0	2
	Reserved	ARRAY[3..15] OF BOOL		0	3

▼	s_CycleStatus	STRUCT	User		
	ReadCyclePassed	BOOL		0	0
	AllCodesFound	BOOL		0	1
	AllCodesRead	BOOL		0	2
	AllCodesMatch	BOOL		0	3
	AllCodesQuality	BOOL		0	4
	ProcessOverrun	BOOL		0	5
	Reserved	ARRAY[6..15] OF BOOL		0	6

Output Assembly Structure (197)



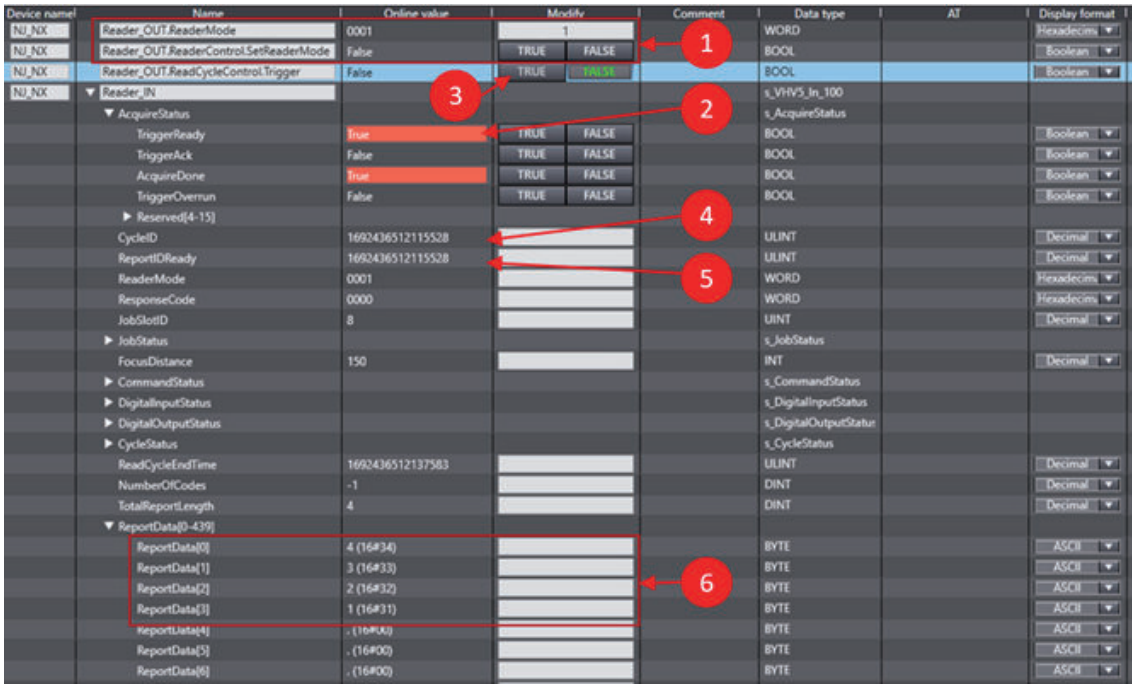
Name	Base Type	Offset Type	Offset Byte	Offset Bit
s_VHV5_Out_197	STRUCT	User		
ReadCycleControl	s_ReadCycleControl		0	
ReportIDAck	ULINT		2	
ReaderMode	WORD		10	
ReaderControl	s_ReaderControl		12	
JobSlotID	UINT		14	
JobControl	s_JobControl		16	
CommandControl	s_CommandControl		18	
FocusDistance	INT		20	
CmdLength	DINT		22	
CmdData	ARRAY[0..255] OF BYTE		26	
DigitalOutputControl	s_DigitalOutputControl		282	
s_ReadCycleControl	STRUCT	User		
UseExtendedDataReportFormat	BOOL		0	0
Trigger	BOOL		0	1
RequireReportAck	BOOL		0	2
Reserved	ARRAY[3..15] OF BOOL		0	3
s_ReaderControl	STRUCT	User		
SetReaderMode	BOOL		0	0
RebootDevice	BOOL		0	1
ResetSystemFault	BOOL		0	2
Reserved	ARRAY[3..15] OF BOOL		0	3
s_JobControl	STRUCT	User		
ChangeJob	BOOL		0	0
SaveJob	BOOL		0	1
Reserved	ARRAY[2..15] OF BOOL		0	2
s_CommandControl	STRUCT	User		
CmdExe	BOOL		0	0
TrainMatchString	BOOL		0	1
SetFocusDistance	BOOL		0	2
Reserved	ARRAY[3..15] OF BOOL		0	3
s_DigitalOutputControl	STRUCT	User		
Output1_Enable	BOOL		0	0
Output2_Enable	BOOL		0	1
Output3_Enable	BOOL		0	2
Reserved	ARRAY[3..15] OF BOOL		0	3

Example of Data Storage

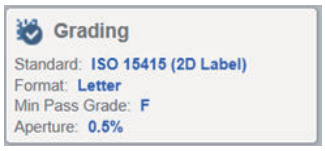
- Read string: 4321

1. If needed, change reader mode to run mode. The PLC changes the Output Assembly memory area - Reader Mode to 1 and changes the Set Reader Mode to TRUE. The PLC Input Assembly memory area – Reader Mode changes to 1.
2. The PLC confirms that Trigger Ready is TRUE indicating that the reader is ready to be triggered.
3. When the Trigger bit is changed FALSE to TRUE, the code reader executes a Read Cycle.
4. After the image capture, Cycle ID changes indicating that the decoding has started.
5. Report ID Ready changes to match the Cycle ID to indicate that the Read Cycle is complete.
6. The decoded data is reported into the Input Assembly memory area.

PLC

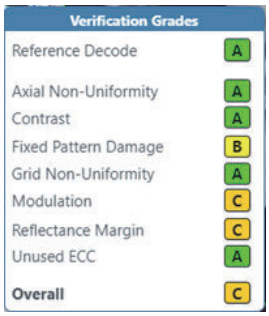


Note: When outputting the Code Quality Grade
DecodeTool Grading: ISO 15415, Letter, F, 0.5%



DecodeTool Output: <Decode Data> <Verification Report>

Read data: *4321,C A A A B A C C A*



Device name	Name	Online value	Modify	Comment	Data type	AT	Display format
	▼ ReportData[0-439]						
	ReportData[0]	4 (16#34)			BYTE		ASCII
	ReportData[1]	3 (16#33)			BYTE		ASCII
	ReportData[2]	2 (16#32)			BYTE		ASCII
	ReportData[3]	1 (16#31)			BYTE		ASCII
	ReportData[4]	, (16#2C)			BYTE		ASCII
	ReportData[5]	C (16#43)			BYTE		ASCII
	ReportData[6]	(16#20)			BYTE		ASCII
	ReportData[7]	A (16#41)			BYTE		ASCII
	ReportData[8]	(16#20)			BYTE		ASCII
	ReportData[9]	A (16#41)			BYTE		ASCII
	ReportData[10]	(16#20)			BYTE		ASCII
	ReportData[11]	A (16#41)			BYTE		ASCII
	ReportData[12]	(16#20)			BYTE		ASCII
	ReportData[13]	B (16#42)			BYTE		ASCII
	ReportData[14]	(16#20)			BYTE		ASCII
	ReportData[15]	A (16#41)			BYTE		ASCII
	ReportData[16]	(16#20)			BYTE		ASCII
	ReportData[17]	C (16#43)			BYTE		ASCII
	ReportData[18]	(16#20)			BYTE		ASCII
	ReportData[19]	C (16#43)			BYTE		ASCII
	ReportData[20]	(16#20)			BYTE		ASCII
	ReportData[21]	A (16#41)			BYTE		ASCII
	ReportData[22]	. (16#00)			BYTE		ASCII
	ReportData[23]	. (16#00)			BYTE		ASCII

A-5 Serial Commands

A-5-1 Serial Command and Control

The reader TCP/IP, UDP, and RS-232 channels are normally used to output result data to a host. These same channels can be used to control the reader as well. This section lists the Serial Command set that can be used to control the reader.

Serial commands are also applicable to EtherNet/IP and PROFINET industrial protocols. If using serial commands with an industrial protocol, the command will not post a response. Instead, the error code will be provided as the subsystem error code in the Input Assembly - Response (fault) code.

The command set allows the host to Trigger the reader, to change the Mode of the reader, to set Key Job Parameters such as focus, lighting, and match string, and to call Quick Set functions such as Quick Photometry and Quick Focus that actively set up imaging.

A-5-2 Serial Command Syntax

1. All Serial Commands start with an ! (hexadecimal 21) followed by the command name.
2. All commands must be uppercase and are case sensitive.
3. All commands must be followed by a carriage return (hexadecimal 0D).

   Example: !TRIGGER<CR>

4. Commands with arguments require a comma between each field.

   Example: !SETMATCHSTR,2,123456<CR>

A-5-3 Serial Command Response

1. All serial commands return an error code when complete. 0 = Success. Note that some commands such as Quick Set commands may take up to 5 seconds to complete.

   Example:
   !RUN<CR>
   Expected Response: !RUN=0<CR><LF>
2. Invalid commands return an error code of 100.

   Example:
   !RUN<CR>
   Expected Response: !RUN=100<CR><LF>
3. Some commands have additional error codes. These codes are listed in the Serial Command section below.

Serial Command Response Format

All serial commands will echo the command sent and the error code. The !TRIGGER and !GET-MATCHSTR command will return additional information after the error code.

For the commands that only return the Error Code, the response will be:
[COMMAND]=[Error Code]<CR><LF>

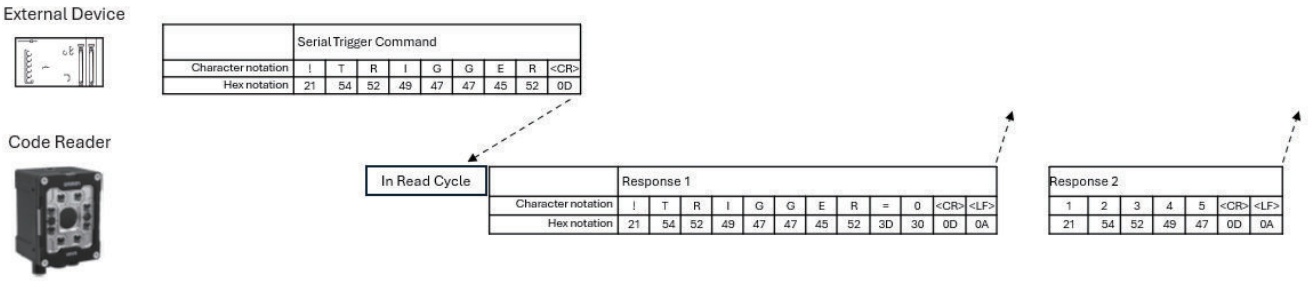
For the TRIGGER command the response will be:
!TRIGGER=[Error Code]<CR><LF>[Format Output]

For the GETMATCHSTR command the response will be:
!GETMATCHSTR=[Capture N],[Match String 1],[Match String 2],…[Match String N]<CR><LF>

Common Error Codes	0	Success
	100	Invalid Command (Typically caused by using lower case characters or misspelling.)

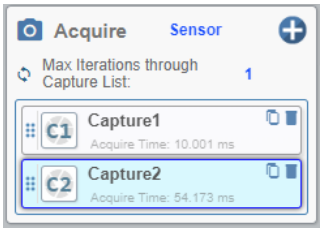
Example 1: Serial Trigger Command

Read string: 12345, Format Output : Preamble: None, Postamble: \r\n
Transmit: !TRIGGER<CR>
Response Format
Response 1: !TRIGGER=0<CR><LF>
Response 2: 12345 <CR><LF>



Example 2: Set Command

Set Capture 2 Gain to 40.
Command Structure: !SETGAIN,<Capture Index >, <gain value><CR>



Transmit: !SETGAIN,2,40<CR>
Response (If Capture 2 is present in Job): !SETGAIN=0<CR><LF>
Response (If Capture 2 is not present in Job): !SETGAIN=2<CR><LF>

	Serial Command														
Character notation	!	S	E	T	G	A	I	N	,	0	,	4	0	<CR>	<CR>
Hex notation	21	53	45	54	47	41	49	4E	2C	30	2C	35	30	0D	0A

	Response if Capture 2 is present in job										
Character notation	!	S	E	T	G	A	I	N	=	0	<CR>	<LF>
Hex notation	21	53	45	54	47	41	49	4E	3D	30	0D	0A

or

	Response if Capture 2 is not present in job										
Character notation	!	S	E	T	G	A	I	N	=	2	<CR>	<LF>
Hex notation	21	53	45	54	47	41	49	4E	3D	30	0D	0A

Example 3: Get Match String Command

Get Decode Tool 1 match string, which has a 2442 stored.
Command Structure: !GETMATCHSTR,<tool index> <CR>

Transmit: !GETMATCHSTR,1<CR>
Response: !GETMATCHSTR=0,2442<CR><LF>

	Serial Command														
Character notation	!	G	E	T	M	A	T	C	H	S	T	R	,	0	<CR>	<LF>
Hex notation	21	47	45	54	4D	41	54	43	48	53	54	52	2C	30	0D	0A

	Response																			
Character notation	!	G	E	T	M	A	T	C	H	S	T	R	=	0	,	2	4	4	2	<CR>	<LF>
Hex notation	21	47	45	54	4D	41	54	43	48	53	54	52	3D	30	2C	32	34	34	32	0D	0A

A-5-4 Serial Commands

!TRIGGER

Description	Sends a soft trigger to the reader.	
Parameters	None	
Return Err Codes	0	Success

Operation: Triggers a Read Cycle if system is in Run or Setup mode.
Mode: System needs to be in Run mode or Setup mode to act on this command.

Example:
!TRIGGER<CR> – Triggers a Read Cycle.
Expected Response 1: !TRIGGER=0<CR><LF>
Expected Response 2: [Format Output]

!RUN

Description	Puts the reader into Run mode.	
Parameters	None	
Return Err Codes	0	Success

Operation: Puts the reader into Run mode and changes user interface to Run view.
Run Mode: Job Change is allowed in Run mode. Job Parameter changes are not allowed.

Example:
!RUN <CR> – Changes reader to Run mode.
Expected Response: !RUN=0<CR><LF>

!SETUP

Description	Puts the reader into Setup mode.	
Parameters	None	
Return Err Codes	0	Success

Operation: Puts the reader into Setup mode and changes user interface to Setup view.
Setup Mode: Job Change is not allowed in Setup mode. Job Parameter changes are allowed.

Example:
!SETUP<CR> – Changes reader to Setup mode.
Expected Response: !SETUP=0<CR><LF>

!OFFLINE

Description	Puts the reader into Offline mode. No triggers are accepted when offline.	
Parameters	None	
Return Err Codes	0	Success

Operation: Puts the reader in Offline mode and changes the user interface to Device view.
Offline Mode: Job is stopped and does not respond to triggers. Job Change is allowed in Offline mode. Job Parameter changes are not allowed.

Example:
!OFFLINE<CR> – Puts the reader in Offline mode.
Expected Response: !OFFLINE=0<CR><LF>

!SETEXPOSURE,<capture index>,<exposure value>

Description	Sets the specified capture to the specified exposure value.	
Parameters	<capture index>	1 based index of the capture you wish to modify.
	<exposure value>	Exposure setting you wish to set into the capture.

Return Err Codes	0	Success
	1	Error: No job is loaded.
	2	Error: Invalid capture index.
	3	Error: Exposure value was out of the valid range.
	101	Invalid command format. Must have at least 2 parameters.

Operation: Directly sets the Exposure Value of the selected Capture in the loaded job.

Example:
!SETEXPOSURE,1,64<CR> – Sets capture 1's exposure setting to 64.
Expected Response: !SETEXPOSURE=0<CR><LF>

!SETGAIN,<capture index>,<gain value>

Description	Sets the specified capture to the specified gain value.	
Parameters	<capture index>	1 based index of the capture you wish to modify.
	<gain value>	Gain value you wish to set into the capture.
Return Err Codes	0	Success
	1	Error: No job is loaded.
	2	Error: Invalid capture index.
	3	Error: Gain value was out of the valid range.
	101	Invalid command format. Must have at least 2 parameters.

Operation: Directly sets the Gain value of the selected Capture in the loaded job.

Examples:

!SETGAIN,1,50<CR> – Sets capture 1's gain setting to 50.
Expected Response: !SETGAIN=0<CR><LF>

!SETGAIN,1,101<CR> – Tries to set capture 1's gain setting to 101, but this is out of the valid range.
Expected Response: !SETGAIN=3<CR><LF>

!SETFOCUS,<capture index>,<focus value>

Description	Sets the specified Capture to the specified Focus value	
Parameters	<capture index>	1 based index of the capture you wish to modify.
	<focus value>	Focus value you wish to set into the capture.
Return Err Codes	0	Success
	1	Error: No job is loaded.
	2	Error: Invalid capture index.
	3	Error: Focus value was out of the valid range.
	101	Invalid command format. Must have at least 2 parameters.

Operation: Directly sets the Focus value of the selected Capture in the loaded job.

Example:
!SETFOCUS,1,150<CR> – Sets capture 1's Focus setting to 150.
Expected Response: !SETFOCUS=0<CR><LF>

!QUICKSET,<capture index>,<do focus>,<do photometry>,<roi left><roi top><roi width><roi height>

Description	Commands the reader to run either a Quick Focus, a Quick Photometry, or both. Optionally allows you to specify a region of interest (ROI) within the image in which to run the operations.	
Parameters	<capture index>	1 based index of the capture on which you wish to run Quick Focus or Quick Photometry.
	<do focus>	Set to 1 if you wish to run the Quick Focus operation, 0 if not.
	<do photometry>	Set to 1 if you wish to run the Quick Photometry operation, 0 if not.
	<roi left>	Optional: Left-most pixel location of a region within the image in which you want to run the operation.
	<roi top>	Optional: Top-most pixel location of a region within the image in which you want to run the operation.
	<roi width>	Optional: Width of the region in which you want to run the operation.
	<roi height>	Optional: Height of the region in which you want to run the operation.
Return Err Codes	0	Success
	1	Error: No job is loaded.
	2	Error: Invalid capture index.
	3	Error: Invalid ROI parameters.
	99	Error: Unexpected error.
	101	Invalid command format. Must have at least 3 parameters.

Operation: Puts the system Offline. Runs Quick Photometry or Quick Focus on the selected Capture. Performs this operation within the specified region of interest (ROI). When done, the system is put back into the previous mode.

Note: This operation can take up to 5 seconds to complete and generate a response.

Examples:
!QUICKSET,1,1,0<CR> – Runs a Quick Focus operation on capture 1.
Expected Response: !QUICKSET=0<CR><LF>

!QUICKSET,2,0,1<CR> – Runs a Quick-Photometry operation on capture 2.
Expected Response: !QUICKSET=0<CR><LF>

!QUICKSET,1,1,1,400,500,400,200<CR> – Runs both a Quick Focus and Quick-Photometry operation on capture 1. These operations will be run within a region of the image starting at pixel 400,500, 400 pixels wide and 200 pixels tall.
Expected Response: !QUICKSET=0<CR><LF>

!JOBCHANGE,<job slot index>

Description	Changes the active job to the job in the specified slot.	
Parameters	<job slot index>	0 based index of the job slot to switch to.

Return Err Codes	0	Success
	2	Error: Unexpected Error
	3	Error: Job does not exist.
	8	Error: Invalid job file. Job could not be loaded because it is corrupt.
	12	Error: Invalid Job Slot specified. Slot was outside the valid range.
	101	Invalid command format. Must have at least 1 parameter.

Operation: Puts the system Offline if it is not already. Changes the Job to the one in the selected slot. When done, the system is put back into the previous mode.

Examples:
!JOBCHANGE,1<CR> – Change jobs to the job in slot 1.
Expected Response if there is a job in slot 1: !JOBCHANGE=0<CR><LF>
Expected Response if there is NO job in slot 1: !JOBCHANGE=3<CR><LF>

!JOBCHANGE,33<CR> – Trying to change to job slot 33, but there are only 32 slots on the VHV5-F.
Expected Response: !JOBCHANGE=12<CR><LF>

!SETMATCHSTR,<tool index>,<match string>

Description	Sets the match string of the specified tool to the specified match string value.	
Parameters	<tool index>	1 based index of the tool with the match string you wish to modify. Set this to -1 if you wish to apply the match string to all tools.
	<match string>	The match string value to set into the specified tool. If the match string contains a comma, it must be escaped. Otherwise it will be treated as a parameter separator.
Return Err Codes	0	Success
	1	Error: tool index is not valid.
	101	Invalid command format. Must have at least 2 parameters.

Operation: Sets the Match String for a specific Decode Tool.

Examples:
!SETMATCHSTR,2,123456<CR> – Sets tool 2's match string to "123456".
Expected Result if tool 2 exists: !SETMATCHSTR=0<CR><LF>
Expected Result if tool 2 does NOT exist: !SETMATCHSTR=1<CR><LF>

!SETMATCHSTR,1,123\,456<CR> – Sets tool 1's match string to "123,456". Comma is escaped.
Expected Result: !SETMATCHSTR=0<CR><LF>

!GETMATCHSTR,<tool index>

Description	Returns the match string(s) for the specified tool. Defaults to tool 0 if no index is specified.

Parameters	<tool index>	Optional: 1 based index of the tool with the match string you wish to retrieve. If you leave off this parameter, then you will get the match string for tool 1.
Return Err Codes	0	Success
	1	Error: tool index is not valid.
	2	Error: specified tool is NOT a symbology tool and so has no match string.
	101	Invalid command format. Must have at least 2 parameters.

Operation: Returns the Match String for a specific Decode Tool.
Note: Command not applicable to EtherNet/IP or PROFINET.

Examples:

!GETMATCHSTR<CR> – Gets the match string from tool 1.
Expected Response (match string=123456): !GETMATCHSTR=0,123456

!GETMATCHSTR,2<CR> – Gets the match string from tool 2.
Expected Response if there is a tool 2: !GETMATCHSTR=0,123456
Expected Response if there is NOT a tool 2: !GETMATCHSTR=1

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